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OF

AGRICULTURAL RESEARCH, PUSA.

TRANSACTIONS

AND

PROCEEDINGS

OF THE

NEW ZEALAND INSTITUTE

1885

VOL. XVIII.

(First of New Series)

EDITED AND PUBLISHED UNDER THE AUTHORITY OF THE BOARD OF GOVERNORS OF THE INSTITUTE

BY

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PREFACE.

THE present volume commences a new series of the "Transactions of the New Zealand Institute," in which, for convenience and economy, the size of the page has been reduced from royal to demy octavo. An alphabetical index has also been added to the volume for the first time. A General Alphabetical Index of Authors and Subjects, for the seventeen volumes which constitute the first series, has been prepared, and will be preser to all members of the Institute along with this

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GAZETTED IN THE "NEW ZEALAND GAZETTE," 9TH MARCH, 1868.

SECTION I.

Incorporation of Societies.

1. No Society shall be incorporated with the Institute under the provisions of "The New Zealand Institute Act, 1867," unless such Society shall consist of not less than twenty-five members, subscribing in the aggregate a sum of not less than fifty pounds sterling annually, for the promotion of art, science, or such other branch of knowledge for which it is associated, to be from time to time certified to the satisfaction of the Board of Governors of the Institute by the Chairman for the time being of the Society.

2. Any Society incorporated as aforesaid shall cease to be incorporated with the Institute in case the number of the members of the said Society shall at any time become less than twenty-five, or the amount of money annually subscribed by such members shall at any time be less than £50.

3. The by-laws of every Society to be incorporated as aforesaid shall provide for the expenditure of not less than one-third of its annual revenue in or towards the formation or support of some local public Museum or Library; or otherwise shall provide for the contribution of not less than one-sixth of its said revenue towards the extension and maintenance of the Museum and Library of the New Zealand Institute.

4. Any Society incorporated as aforesaid, which shall in any one year fail to expend the proportion of revenue affixed in manner provided by Rule 3 aforesaid, shall from thenceforth cease to be incorporated with the Institute.

5. All papers read before any Society for the time being incorporated with the Institute shall be deemed to be communications to the Institute, and may then be published as Proceedings or Transactions of the Institute, subject to the following regulations of the Board of the Institute regarding publications:—

Regulations regarding Publications.

(*a.*) The publications of the Institute shall consist of a current abstract of the proceedings of the Societies for the time being incorporated with the Institute, to be intituled, "Proceedings of the New Zealand Institute," and of transactions, comprising papers read before the Incorporated Societies (subject, however, to selection as hereinafter mentioned), to be intituled, "Transactions of the New Zealand Institute."

(*b.*) The Institute shall have power to reject any papers read before any of the Incorporated Societies.

(*c.*) Papers so rejected will be returned to the Society before which they were read.

(*d.*) A proportional contribution may be required from each Society towards the cost of publishing the Proceedings and Transactions of the Institute.

(*e.*) Each Incorporated Society will be entitled to receive a *proportional* number of copies of the Proceedings and Transactions of the Institute, to be from time to time fixed by the Board of Governors.

(*f.*) Extra copies will be issued to any of the members of Incorporated Societies at the cost price of publication.

6. All property accumulated by or with funds derived from Incorporated Societies and placed in the charge of the Institute, shall be vested in the Institute, and be used and applied at the discretion of the Board of Governors for public advantage, in like manner with any other of the property of the Institute.

7. Subject to "The New Zealand Institute Act, 1867," and to the foregoing rules, all Societies incorporated with the Institute shall be entitled to retain or alter their own form of constitution and the by-laws for their own management, and shall conduct their own affairs.

8. Upon application signed by the Chairman and countersigned by the Secretary of any Society, accompanied by the certificate required under Rule No. 1, a certificate of incorporation will be granted under the Seal of the Institute, and will remain in force as long as the foregoing rules of the Institute are complied with by the Society.

SECTION II.

For the Management of the Property of the Institute.

9. All donations by Societies, Public Departments, or Private Individuals to the Museum of the Institute, shall be acknowledged by a printed

form of receipt, and shall be duly entered in the books of the Institute provided for that purpose, and shall then be dealt with as the Board of Governors may direct.

10. Deposits of articles for the Museum may be accepted by the Institute, subject to a fortnight's notice of removal to be given either by the owner of the articles or by the Manager of the Institute, and such deposits shall be duly entered in a separate catalogue.

11. Books relating to Natural Science may be deposited in the Library of the Institute, subject to the following conditions:—

(*a*.) Such books are not to be withdrawn by the owner under six months' notice, if such notice shall be required by the Board of Governors.

(*b*.) Any funds specially expended on binding and preserving such deposited books at the request of the depositor, shall be charged against the books, and must be refunded to the Institute before their withdrawal, always subject to special arrangements made with the Board of Governors at the time of deposit.

(*c*.) No books deposited in the Library of the Institute shall be removed for temporary use, except on the written authority or receipt of the owner, and then only for a period not exceeding seven days at any one time.

12. All books in the Library of the Institute shall be duly entered in a catalogue, which shall be accessible to the public.

13. The public shall be admitted to the use of the Museum and Library, subject to by-laws to be framed by the Board.

Section III.

The Laboratory shall, for the time being, be and remain under the exclusive management of the Manager of the Institute.

Section IV.

Of Date 23rd September, 1870.

Honorary Members.

Whereas the rules of the Societies incorporated under the New Zealand Institute Act provide for the election of Honorary Members of such Societies; but inasmuch as such Honorary Members would not thereby become members of the New Zealand Institute, and whereas it is expedient to make provision for the election of Honorary Members of the New Zealand Institute, it is hereby declared—

1st. Each incorporated Society may, in the month of November next, nominate for election as Honorary Members of the New Zealand Institute three persons, and in the month of November in each succeeding year, one person, not residing in the colony.

2nd. The names, descriptions, and addresses of persons so nominated, together with the grounds on which their election as Honorary Members is recommended, shall be forthwith forwarded to the Manager of the New Zealand Institute, and shall by him be submitted to the Governors at the next succeeding meeting.

3rd. From the persons so nominated, the Governors may select in the first year not more than nine, and in each succeeding year not more than three, who shall from thenceforth be Honorary Members of the New Zealand Institute, provided that the total number of Honorary Members shall not exceed thirty.

LIST OF INCORPORATED SOCIETIES.

NAME OF SOCIETY.	DATE OF INCORPORATION.
Wellington Philosophical Society	10th June, 1868.
Auckland Institute	10th June, 1868.
Philosophical Institute of Canterbury	22nd October, 1868.
Otago Institute	18th October, 1869.
Westland Institute	21st December, 1874.
Hawke's Bay Philosophical Institute	31st March, 1875.
Southland Institute	21st July, 1880.
Nelson Philosophical Society	20th December, 1883.

OFFICERS OF INCORPORATED SOCIETIES, AND EXTRACTS FROM THE RULES.

WELLINGTON PHILOSOPHICAL SOCIETY.

Office-bearers for 1886.—*President*—James Hector, M.D., C.M.G., F.R.S.; *Vice-presidents*—F. B. Hutchinson, M.R.C.S., W. T. L. Travers, F.L.S.; *Council*—Martin Chapman, Hon. G. R. Johnson, M.L.C., W. M. Maskell, F.M.S., A. de B. Brandon, jun., Charles Hulke, F.C.S., A. K. Newman, M.B., M.R.C.P., R. Govett; *Secretary and Treasurer*—R. B. Gore; *Auditor*—W. E. Vaux.

Extracts from the Rules of the Wellington Philosophical Society.

5. Every member shall contribute annually to the funds of the Society the sum of one guinea.

6. The annual contribution shall be due on the first day of January in each year.

7. The sum of ten pounds may be paid at any time as a composition for life of the ordinary annual payment.

14. The time and place of the General Meetings of members of the Society shall be fixed by the Council and duly announced by the Secretary.

AUCKLAND INSTITUTE.

Office-bearers for 1886:—*President*—Professor F. D. Brown, B.Sc.; *Vice-presidents*—J. A. Pond, H. G. Seth Smith; *Council*—J. Baber, C.E., C. Cooper, Hon. Colonel Haultain, E. A. Mackechnie, J. Martin, F.G.S., J. M. Moore, M.D., T. Peacock, M.H.R., Rev. A. G. Purchas, M.R.C.S.E., S. P. Smith, F.R.G.S., J. Stewart, C.E., Professor A. P. Thomas, F.L.S.; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S., F.Z.S.; *Auditor*—J. Reid.

Extract from the Rules of the Auckland Institute.

1. Any person desiring to become a member of the Institute shall be proposed in writing by two members, and shall be ballotted for at the next meeting of the Council.

4. New members on election to pay one guinea entrance-fee, in addition to the annual subscription of one guinea, the annual subscriptions being payable in advance on the first day of April for the then current year.

5. Members may at any time become life-members by one payment of ten pounds ten shillings, in lieu of future annual subscriptions.

10. Annual General Meeting of the Society on the third Monday of February in each year. Ordinary Business Meetings are called by the Council from time to time.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

OFFICE-BEARERS FOR 1886.—*President*—A. D. Dobson; *Vice-presidents*—W. H. Symes, M.D., and Geo. Hogben, M.A.; *Hon. Treasurer*—H. R. Webb; *Hon. Secretary*—Charles Chilton, M.A.; *Hon. Auditor*—C. R. Blakiston; *Council*—Professors Hutton and Haslam, Messrs. C. E. Bevan, Brown, R. W. Fereday, T. Cook, S. Hurst, Seager.

Extracts from the Rules of the Philosophical Institute of Canterbury.

21. The Ordinary Meetings of the Institute shall be held on the first Thursday of each month during the months from March to November inclusive.

35. Members of the Institute shall pay one guinea annually as a subscription to the funds of the Institute. The subscription shall be due on the first of November in every year. Any member whose subscription shall be twelve months in arrear shall cease to be a member of the Institute, but he may be restored by the Council if it sees fit.

37. Members may compound for all annual subscriptions of the current and future years by paying ten guineas.

OTAGO INSTITUTE.

OFFICE-BEARERS FOR 1886.—*President*—Professor Parker; *Vice-presidents*—Dr. Hockin and Mr. G. M. Thomson; *Honorary Secretary*—Professor Scott; *Honorary Treasurer*—Mr. J. C. Thomson; *Council*—Alexander Wilson, M.A., Dr. Petrie, M.A., D. Colquhoun, M.D., F. R. Chapman, J. De Zouche, M.D., H. Skey; *Auditor*—D. Brent, M.A.

Extracts from the Constitution and Rules of the Otago Institute.

2. Any person desiring to join the Society may be elected by ballot, on being proposed in writing at any meeting of the Council or Society by two members, and on payment of the annual subscription of one guinea for the year then current.

5. Members may at any time become life-members by one payment of ten pounds and ten shillings in lieu of future annual subscriptions.

8. An Annual General Meeting of the members of the Society shall be held in January in each year, at which meeting not less than ten members must be present, otherwise the meeting shall be adjourned by the members present from time to time, until the requisite number of members is present.

(5.) The session of the Otago Institute shall be during the winter months, from May to October, both inclusive.

WESTLAND INSTITUTE.

Office-bearers for 1886.—*President*—T. O. W. Croft; *Vice-president*—J. P. Will; *Treasurer*—C. F. A. Broad; *Committee*—W. A. Spence, Wm. Kenny, Jno. Nicholson, H. L. Robinson, A. H. King, C. Horgan, E. B. Sammons, J. W. Souter, G. Clarkson, Captain Bignell, James Park, Rev. H. Gould; *Secretary*—Richard Hilldrup.

Extracts from the Rules of the Westland Institute.

3. The Institute shall consist:—(1) Of life-members, *i.e.*, persons who have at any one time made a donation to the Institute of ten pounds ten shillings or upwards; or persons who, in reward of special services rendered to the Institute, have been unanimously elected as such by the Committee or at the general half-yearly meeting. (2) Of members who pay two pounds two shillings each year. (3) Of members paying smaller sums, not less than ten shillings.

5. The Institute shall hold a half-yearly meeting on the third Monday in the months of December and June.

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

Office-bearers for 1886.—*President*—W. I. Spencer; *Vice-president*—J. Goodall, M.I.C.E.; *Council*—H. Hill, F. W. C. Sturm, S. Locke, N. Heath, J. T. Carr, A. P. Sheath; *Hon. Secretary and Curator*—A. Hamilton; *Hon. Treasurer*—J. N. Bowerman; *Auditor*—T. K. Newton.

Extracts from the Rules of the Hawke's Bay Philosophical Institute.

3. The annual subscription for each member shall be one guinea, payable in advance on the first day of January in every year.

4. Members may at any time become life-members by one payment of ten pounds ten shillings in lieu of future annual subscriptions.

(4.) The session of the Hawke's Bay Philosophical Institute shall be during the winter months from May to October, both inclusive; and general meetings shall be held on the second Monday in each of those six months, at 8 p.m.

SOUTHLAND INSTITUTE.

Office-bearers for 1886.—*President*—Dr. Galbraith; *Vice-president*—Ven. Archdeacon Stocker; *Council*—Messrs. Bailey, Scrutton, Mehaffey, Cuthbertson, and Dr. Closs; *Treasurer*—Mr. Robertson; *Secretary*—Mr. E. Webber.

NELSON PHILOSOPHICAL SOCIETY.

Office-bearers for 1886.—*President*—A. S. Atkinson; *Vice-presidents*—The Bishop of Nelson and J. Meeson, B.A.; *Secretary*—Dr. Coleman; *Treasurer*—A. K. Somerville; *Council*—Dr. L. Boor, Dr. J. Hudson, J. Holloway, J. S. Browning, and W. S. Littlejohn; *Curator*—Dr. Hudson.

Extracts from the Rules of the Nelson Philosophical Society.

4. That members shall be elected by ballot.

6. That the annual subscription shall be one guinea.

7. That the sum of ten guineas may be paid in composition of the annual subscription.

16. That the meetings be held monthly.

23. The papers read before the Society shall be immediately delivered to the Secretary.

TRANSACTIONS.

TRANSACTIONS

OF THE

NEW ZEALAND INSTITUTE,

1885.

I.—MISCELLANEOUS.

Art. I.—*The Maori in Asia.*

By E. Tregear.

[*Read before the Philosophical Society, Wellington, 12th August,* 1885.]

One who is an authority on Philology (Dr. Latham), when commenting on the Polynesian language, says "The first thing which commands attention is its thorough insular or oceanic character."

It is this mistake, made by all the other European scientists also, which it is my endeavour to correct; so far from being insular, its every word is kindred to the speech of the mainland, and, far from being oceanic, it stretches from Iceland and the Isle of Man across the continents of Europe and Asia.

In reading this paper, I must consider the argument used in "The Aryan Maori" as being in the possession of my hearers. I have arrived at the conclusion, mainly by the evidence of language, that the Maori is a branch of that great race which conquered and occupied the major part of Europe, Persia, and India. Of the three divisions of language, the monosyllabic, the agglutinated, and the inflected, the Aryans have been supposed to possess the characteristic of an inflected grammar, while the Maori has been set down among the agglutinated group. But, however true it may be that the Aryan languages are NOW inflected, I think it can hardly be pretended that they were always thus; grammar is a mere matter of development, and the primitive tribes from whom we are all descended troubled themselves little with the intricacies of scholasticism; the "bare-limbed men with stone axes on their shoulders" who conquered Europe had not conquered the Greek grammar, nor had the victors over the Nagas of India evolved the "rules of external and internal Sandhi" to vex the soul of the student of Sanscrit. The Maori has crystallized his speech in that mode which the primitive Aryans used, perhaps 4,000, perhaps 6,000 years ago.

It may be said, perhaps, that I throw too much importance into the resemblances of words, and that the community of language is not the only conclusive proof of unity of race. But, each to his own department, it will be for the geologist, the anthropologist, and the general historian to deal with the question more fully—where I go outside the province of language I do so only in the briefest manner. But it is to language that the scientist looks for his most conclusive evidence of common descent. The measurement of skulls, the comparisons of religions, the groupings by shades of colour, would never have led to the certainty that the dusky Hindoo was brother to the fair Prussian, had not the testimony of language been decisive. A change of locality induces alteration in the lower animals far greater than any variety in the races of men; the pig, transported to South America, becomes in some cases red, in some black; it gets a thick fur, underneath which is wool, some even have solid hoofs; the number of the vertebræ differs in different species, and the wild hog has six incisor teeth in the upper jaw, and six in the lower, while the tame animal has only three. According to M. de Quatrefages there is a race of cattle in Piacentino which have fourteen pairs of ribs instead of thirteen. Dr. Draper affirms that darkness or fairness of skin depends on the manner in which the liver performs its duties, and that colour has no reference to race. The ravages made by even half a century of degradation, are well shown by Brace in his manual of Ethnology: "Malacca," says Dr. Yvan, "has about 30,000 inhabitants. This population is composed of Portuguese, Dutch, English, and Chinese. Among the inhabitants of European origin, the Portuguese are the most numerous. They are, for the most part, descendants of the ancient conquerors of Malaisia. Their fathers were the companions of Vasco di Gama and Albuquerque, but like the monuments that their ancestors raised, and which cover the soil of their ruins, they also have been injured by degradation and age." After mentioning that they are lower in every way than the Malay, that even their features have put on an Ethiopian type, he resumes: "The majority bear illustrious names, and they are ignorant who were their fathers, and what ray of the past pierces their obscurity. In the space of half a century, perhaps, religion, morals, traditions, written transmission of thought, are effaced from their remembrance."

The Maoris have had no such fall; in their religion, their language, their customs, they seem simply not to have advanced, but among them we stand as we should have stood among our own ancestors in the age of polished stone weapons, the Neolithic period. I will, then, revert to the chief line of scientific comparison, that of language, and will compare Maori with tongues now spoken. First, the Aryan of Persia and Hindustan. Hindustani is scarcely to be called a language; it is a compound of

three great languages—Sanscrit, Persian, and Arabic. Of the Maori agreement with older Sanscrit I gave many examples in the "Aryan Maori"—when a dictionary (which I have ordered from England) arrives, I shall be able to show the older forms at a greater length. The words I shall call Sanscrit are those written in the Hindu dictionary in Sanscrit characters, the Persian being written in Persian. The Arabic is a Semitic tongue, and I do not understand it. Let it be remembered that probably the Hindu and the Maori languages have been flowing apart in two distinct streams for over 4,000 years, and I think the following examples will be thought to be very strange coincidences indeed.

In showing these comparisons I must remind my listeners that *ng* and *k* are interchangeable, that *r* and *l* are interchangeable, *r* and *d*, *p* and *b*, and that the Maori language insists on a vowel following a consonant, thus *plu* would be *poru* or *puru*. English instances of the interchange of *r* and *l* are—Prince Harry into Prince Hal, Sarum into Salisbury, &c. The *ng* into the *k* sound is finely shown in the Latin—*tango* becoming *tactus; pingo, pictus*, &c., so that all these changes have Aryan features. A good example of *r* to *d* is the Maori *ra*, a day, changes to the Danish *dag*, the German *tag*, the English *day*—the German and Danish interchange of *d* to *t* being equal to that of Sanscrit to Maori, as will be shown by examples.

HINDUSTANI.

SANSCRIT.	MAORI.
Ukhar, to root up	*Hauhake*, to root up crop
ukhar, to extirpate	*ukupapa*, to finish, consume
apas, fraternity	*apo*, to gather, together
apas, fraternity	*apu*, a company of labourers
utar, to cross, low water	*uta*, the land, coast
utar, the fare (ferry)	*utu*, the price paid
utarna, to transport, carry	*uta*, to load a vessel
atur, to hurry	*atea*, to clear out of the way *atute*, to jostle
var, a day	*wa*, a division of time
achun, a teacher	*ako*, to teach or learn
ar, contention, dispute	*arita*, irascible
as, to desire, have children	*ai*, to procreate
akirat, defamation	*akiri*, to reject
ankh, the eye	*anga*, to look
agda, firm, strong	*akuaku*, firm, strong
age, before, beyond	*ake*, before, onwards
age, to press forward	*aki-aki*, to urge on
alang, the way, direction	*ara*, the path
anokha, singular, rare	*anake*, only
ani, the point (of an arrow)	*ane-ane*, sharp

SANSCRIT.	MAORI.
bat, to speak, question	*patai*, to question
bak, to speak	*pakiki*, to question *pakiwaha*, boastful
bal, a baby	*parare*, to bawl
bal, the hair	*pare*, a band for the hair
bal, a sprout	*pariri*, a sprout
ban, an arrow	*pana*, to thrust away *panga*, to throw
ban, form, colour	*pani*, to paint
bao, wind, flatulence	*pahu*, to burst, explode
bach, a root	*pakiaka*, a root
burra, seed	*pura-pura*, seed
Barahi, the goddess of eruptive diseases	*para*, affected with pimples
baru, jungle grass	*paru*, to thatch
birash, to separate	*pirara*, to be separated
barah, a homestead	*para*, to fell bush, to clear
bara, cakes	*parare*, food
bara, worthy, eminent	*para*, bravery, spirit
barhna, to increase, expand	*purena*, to run over
basula, an adze	*pahore*, scraped off
bagla, a wading bird	*pakura*, a swamp hen (pukeko)
bala, a beam	*para*, a tree cut in halves down the middle
bulbula, to bubble	*pu-pu*, to bubble up, boil
bahu, a wife (from *vah* to carry)	*wahine*, a woman, wife
bhoj, to eat	*po-poa*, sacred food
bhor, the dawn	*puao*, the dawn
bhuk, the stomach	*puku*, the stomach
bhushan, jewels, embellishment	*puhi-puhi*, feathers or ornament for the hair *puiaki*, treasure
bhuka, longing, fond	*puku*, the affections *puka*, jealous
bhuka, hungry	*puku*, without food
bhola, artless, simple	*porahu*, awkward
bhunna, to burn	*pahunu*, to burn
bhae, to fear	*pairi*, afraid
bhapara, deceit	*paparua*, double
bhuchkana, to scare	*pukana*, to stare wildly
bhurkhas, splinters	*piraka*, firewood
bhirai, contact	*piri*, to come close
bhirai, to fight	*pi-piri*, to join battle
bhagana, to rout	*pakanga*, hostilities
bhaggi, flight	*pake-pake*, to put to flight *paketu*, to clear off
bika, crooked	*peka*, to branch, turn aside

SANSCRIT.	MAORI.
ghin, disgust, aversion	*kino*, bad *keno-keno*, stinking, offensive
ghuggu, an owl	*kokou*, an owl
ghan, clouds	*konga*, cloudy
ghi, butter	*kinaki*, a relish
gabbha, bedding	*kapi*, to be covered
gatta, a cork, plug	*kati*, shut, closed
gathi, a small bundle	*ka-kati*, to tie in bundles
garra, reddish	*kura*, red
gal, the throat	*koro-koro*, the throat
gulal, red powder	*kura*, red
gobar, cow-dung used for plastering the floor	*kaupa-pa*, a floor
gobar, a deity over cattle	*kaupa-pa*, a wise man, oracle
gopiya, a sling (used to drive away cattle)	*kopere*, a sling
gora, fair, white	*korapu*, to shine *korako*, albino
gol, a channel	*korou*, a channel
gol, round, annular	*koru*, looped
khal, a hide	*kiri*, a hide
khad, to dig	*kari*, to dig for
kyari, a garden bed	*keri*, to dig
ket, a comet	*kotiri*, a meteor
khas, a load	*kawe*, to carry
kya, what ?	*kia*, when ?
kat, to cut	*koti*, to cut
kaj, a feast, dinner	*kai*, food
kakatua, crested parrot (cockatoo)	*kaka*, a parrot
kam, skill, dexterity	*ka-kama*, quick, nimble
kan, to say bitter things	*kanga*, to curse
kachcha, green	*kakariki*, green
kapkapi, to tremble, shake	*kapekapeta*, to flutter, writhe
karva, bitter	*kawa*, bitter
kus, a mattock	*ko*, a spade (a sort of)
Dhori, the bull	Maori graft-words, *tara*, &c.

This is useful as showing the change of *d* into *t*.

din, poor, a pauper	whaka-*tina*, to treat as a slave
daur, a string	*tau*, a string
dudhi, the breast (mother's)	whaka-*tete*, to milk
dhara, a robber	*tahae*, a thief
dhaga, a thread	*taka*, a thread
dahana, to burn the dead	*tanu*, to bury *tahu* (*tahuna*), to set on fire

(Referred to afterwards.)

dhava, a march, attack	*taua*, a war party

SANSCRIT.	MAORI.
dhur, far-off	*turehu*, indistinctly seen
dhura, a boundary	*turi*, a fence-post *turaha*, to keep away
dharalla, a swarm	*tararau*, to make a loud confused noise
dhakka, to push, shove	whaka-*taka*, to throw down
dhakka, to fall frequently	*tataka*, to fall off
dhan, riches, property (but especially cattle)	*tana*, his (possessive) *taonga*, property
Compare (Lat.)	*pecu* and *pecunia*.
dhup, the sunshine, warmth	*tupu*, to glow, redness
dubdha, doubt	*tupua*, strange, uncertain
dabna, to be concealed	*tapanihi*, to go stealthily
dabak, to hide	*tapaki*, to cover
tao, to heat	*ta-tao*, a long while cooking *tao-puku*, cook (wrapt in leaves)
tujh, thine	*tau*, thine
tevar, eyesight	*tiwha*, to squint
tiya (and *tia*) a boundary mark	*tia*, to drive in posts or pegs *tia-roa*, straight side (as of a pa)
tiri! have mercy! save us!	*tiri*, offering to a deity
tangi, a hatchet	*toki*, an axe
tar tar, piece by piece	*tatau*, to count
tar tar, to tear to pieces	*ta-tau*, to attack
tat, darling	"*te tau o te ate*," darling of one's heart
tabar tor, one after the other	*tapa-tahi*, one by one
tara, a star	*tara*, to throw rays
tar, to strike	*ta*, to strike with a stick
taga, a thread	*taka*, a thread
taiki, an ear-ring	*taringa*, the ear *hei-tiki*, a pendent ornament (*hei*, to wear)
tur turi, a trumpet	*tetere*, a trumpet
tircha, oblique	*tiraha*, to lean
tari, chastisement	whaka-*tari*, expose to chastisement
tarera, a buoy	*tarewa*, a buoy, float
tallar, the belly	*tara-uma*, the chest
tui, lace	*kotui*, lace
thap, to thump	*tapa*, to pulverize soil
thakka, a heap	*taka*, a heap
thora, a few	*torutoru*, few
tel, oil	*tere*, to float *tere-tere*, to be liquid
tar, to go	*taha*, to pass by *taawhe*, go round a corner

SANSCRIT.	MAORI.
tital, cheating	*tito*, to invent, lie
hela, to shove, push	*hirau*, a paddle
hel, a basket of cow-dung	*hereumu*, a cooking-shed
hullar, a crowd	*hura-hura*, visitors
nata, kindred	*ngati*, a tribe, or relations
nichor, the end, termination	*neku-neku*, to decline (as the sun)
nain, the eye	*nana*, the eyebrow
nikki, small	*nohi-nohi*, small
lar, a line, row	*ra-ranga*, a row
lagu, adhering	*raka*, entangled
lapat, the flame	*ra-rapu*, to flash forth
lata, a creeper, vine	*rata*, a creeper, vine
latar, overwork, fatigue	*rata*, tame, quiet
lank, a quantity	*ranga*, a shoal of fish
mohri, ends of a garment	*more-morenga*, the end
mae, a harrow	*maea*, to take up crop
mantar, a spell charm	*mata*, a charm
mok, silent, dumb	*moke-moke*, solitary, lonely
mukh, the mouth, face	*moka*, a muzzle
musli, the tap-root	*more*, the tap-root
mutthi, the hand	*matau*, the right hand
manana, to persuade	*manene*, importunate
moh, affection, love	*momo*, offspring
matkana, to ogle, wanton with the eyes	*matakana*, to be on the lookout, look shy
mota, fat	*matu*, fat
mat, understanding	*matau*, to know
matha, the forehead	*mata*, the face
mala, a necklace, rosary	*maro*, a girdle
pata, a sword	*patu*, a weapon
partala, a sword-belt	*patai*, a girdle
purya, an offering to a deity	*pure*, a ceremony of lifting tapu
pat, a screen, veil	*patu*, a wall-screen
pakka, matured, cooked	*paka*, dried *pakari*, matured *vaku*, dried, set
pott, to cover	*potae*, a hat, to cover
phari, a small shield	*pare*, to ward off
phut, an opening	*puta*, to pass through, a hole
pi, to love	*pie*, to desire earnestly
pet, the belly	*pito*, the navel
pallu, the border, edge	*parua*, edge of a bowl
pau, the grey dawn	*puao*, the dawn
pokhar, a pool	*poka*, a well, hole
paun, three-quarters	*punga*, an odd number
poe, *poya*, a pot-herb	*puwha*, sowthistle, greens
pat, a foot	*patere*, a dance

SANSCRIT.	MAORI.
patar, a dancing girl	*patere*, a dance
papar, cutaneous disease	*paipai*, cutaneous disease
pat, sound of breaking	*pato*, to crack *patate*, to crack
py-s, milk	*pi-pi*, to ooze, *pia*, gum of trees
pat, a platform	*patuka*, a raised food-store
chapar, hard soil	*tapa*, to pulverise soil
chapana, to chew or bite	*tapa*, chapped *tapahi*, to chop *tapa-tapahi*, cut in pieces
chup, silence, stillness	*tupo*, the cave where the bones of the dead were deposited *tupe*, to deprive of power by a charm
chippi, a patch	*tapi*, to patch
chat, instantly	*tata*, sudden
chat, a scratch or scar	*ta*, to tattoo
chitrana, to scatter, strew	*titari*, to strew
chatrao, scattering	*tatari*, to sift, strain
chut (in comp.), common, poor people	*tutua*, ignoble, low born
chahka, the pavement, floor	*takahi*, to trample on
cho, anger	*totohe*, to contend
cho, love, affection	*topu*, to pair *tohu*, to preserve
chir, milk (white)	*tea*, white (from *tete* to milk)
chekke, pudendum muliebre	*teke*, pudendum muliebre
chivar, tattered clothes	*ti-tiwha*, in patches
charcha, talk, report	*tutara*, gossip
jeli, a rake	*heru*, a comb
jai, to be born	*ai*, to procreate
jab, at the time, when	*apanoa*, until
jag, a feast, entertainment	*haka*, a dance song *hakari*, a feast
jani, a fainting fit	*anini*, giddy, dizzy
joru, a wife, consort	*hoa*, a wife or friend
joe, *jo*, a wife	*hoa*, a wife (Scotch *joe*, a sweetheart)
jhari, a jar or pitcher	*hari*, to carry
sumeru, the holy mountain Meru; *sumeru*, the North Pole	*hume*, to bring to a point (the Maoris of old knew the point of stellar revolution)
suji, a needle, awl	*uhi*, the tattooing needle
swargi, celestial, heavenly	*Hawaiki* (savaiki)
soka, frost-bitten crops	*huka*, a frost
sel, a spear	*here*, a spear
ragi, a singer	*rangi*, a song

SANSCRIT.	MAORI.
rang, to be melted	*rangitoto*, scoria
rae, a prince	*rae*, a headland, forehead *rei*, a jewel whaka-*rei*, canoe with carved figure-head, bust, and arms
rati, enjoyment, intercourse	*rata*, familiar, friendly
ris, anger	*ri-ri*, anger
rassi, a rope	*rahiri*, a rope
rala, mingling, union	*rara*, to go in shoals
rau, a host, swarm	*rau*, a hundred
ruhk, (Pali, *rukkho*) a tree	*rakau*, a tree
rukha, dry	*raki*, dry, dried up
raula, noise	*rara*, to roar
rauna, a noose	*tarona*, to strangle
ruha, old	*ruruhi*, an old woman *ru-wahine*, an old woman

Persian.

PERSIAN.	MAORI.
gor, a waste	*koraha*, a desert
pari, winged	*parirau*, a wing
ravan, expert, dexterous	*rawe*, excellent
ravan, flowing, liquid	*rewa*, to melt, float
ravangi, embarkation	*rawahi*, the other side of a river
roz, the day	*ra*, a day
rez, pouring, dripping	*re-re*, falling water
rez ish, running at the nose	compare (M.) *ihu*, the nose
charagah, grazing land	*tarake*, to clean the ground
chopa, boiled rice	*topa*, cook in a hangi
charkh, the celestial sphere	*taka*, on all sides, all round
langar, a rope, a cloth	*ra-ranga*, to weave
pak, clear, fair	*paki*, fair, without rain
puch, empty	*pute*, a bag *puta*, a hole
dar, a door *duar*, a door	*ta-tau*, a door
daraz, extended	*tara*, rays, spines
darah, a crack, fissure	*tarahanga*, an indentation
taryai, the sea	*tai*, the sea
dam, breath, life	*tama*, a son *tama-hine*, a daughter
parva, anxiety, concern	*pawera*, solicitous, anxiety
parhez, keeping aloof	*pare*, to fend off
pashm, hair, wool	*pahau*, the beard
derah, a tent	*tiraha*, a bundle *tira*, a mast (the mast was originally a tent-pole), plain-dwellers

PERSIAN.	MAORI.
rah, the road	*ara*, the road
	huarahi, road
rasa, welcome	*rahui*, to welcome
rasai, power of mind	*rae*, the forehead
tudah, a mound	*toropuke*, a mound
tir, an arrow	*tiri*, to throw one by one
tez, sharp-pointed	*te-te*, the head of a spear
	tei-tei, the summit
	tia, to stick in
geshu, a ringlet	*kehu*, hair (in com.)
tab, penalty, forfeit	*tapu*
tabahi, destruction	*tapahi*, to chop to pieces
tabar, an axe	
tarash, to shave	*tarai*, to adze
tazi, recent, fresh	*tae*, to arrive
mom, soft, waxy	*momona*, fat, rich
mir, a chief	*mira-mira*, to give prominence to
	whaka-*mira-mira*, to treat with deference
	mira, to cherish
dur, remote, far off	*tara* (*korero tara*), a fable
	turara, spread out
doz, to sew	*tui*, to sew
khak, not at all	*kauaka*, dont !
khak, to be overcast	*kakarauri*, to be dusk
khan, a noble	*kanapu*, bright, shining (compare (Sk.) *rajah*, from *raj* to shine)
kham, green, unripe	*kaimata*, green, uncooked
khunak, cold	*kuiki*, cold
	koangi, cold
	koanu, cold
khuari, vileness, abjectness	*kuare*, ignorant, low
khuah, to desire	*kuika*, desire
khur, to eat	*kai*, to eat
khush, pleased, delighted	*koa*, joy, pleasure
khuni, a murderer	*konihi*, to murder by stealth
khuni dast, dysentery	*konao*, diarrhœa
dar, holding	*tau*, to hold
dar, a stake	*tau-hokai*, stake for nets
baz, a hawk	*paho*, soaring
	whako-*paho*, to soar
bahanah, a stratagem, excuse	*paheno*, to slip away, escape
baja, good, right	*pai*, good
agah, knowing, informed	*ako*, to learn or teach
danu, corn	*tanu*, to plant.

I will beg you to consider this as no mere idle list of words; many of them are full of history, and open strange doors into the past of our race. I will give a few instances well worthy of attention: In Maori the word "*kotaha*" has two meanings, one, that of "a sling," and the other, "part of a chief's head-dress." Very few men now living have seen the chiefs with their hair dressed in the old fashion—the *putiki*, *ngoungou*, &c., are not now used. The Maoris do not seem (at all events for a very long time) to have used the sling in warfare, and thus stand in marked contrast to many other Polynesian Islanders, with whom the sling is an effective and terrible weapon. Another Maori word for sling is *kopere*, and its Sanscrit equivalent is "*gopiya*," a sling used to drive away cattle—(*go*, the cow). The Maori word for a fillet, or band for the hair, is *pare*, so that *kopere*, a sling, was also a hair-band, like *kotaha*. But this word *pare*, a band for the hair, is derived from *pareho*, the head, and this *pareho* is only our English word "brow," the forehead. We see this word in two forms in Maori; the Scottish word *brae* means the brow of a hill, shortened in Maori into *rae*, the forehead, or a headland; again, it is lengthened out into *pareho*, the head. I was for some time puzzled to know the derivation of the (M.) word *korero*, to speak or talk. According to my theory of graft words, it should, by its prefix *ko*, have had originally something to do with "cow." I analysed the part "*rero*," with these results: Connected with *speech* is the word *a-rero*, the tongue, represented by the Polynesian *alelo* or *aledo*. In Sanscrit *lal* is to put out the tongue; in Greek *lalao* is to speak, and *eiro* to speak—these seemed cognate words, but still far from the Sanscrit word "*vach*," speech. Then, suddenly remembering that the vocative of *vach* was *vak*, I saw the connection with (Lat.) *vacca*, a cow. The Sanscrit *vach* means more than mere speech or language, it was personified as the Goddess of Speech. In the Atharva-veda we find—"That daughter of thine, Oh Kama, is called the cow, she whom sages denominate Vach," she is the mother of the Vedas, the fount of wisdom, "the melodious cow who milked forth sustenance and water." So there is some reason also why the Maoris should call speech "the cow's tongue," *korero*. Another word for speech in Maori also has the prefix *ko*, that is *koroki*—the latter part of this word (by change of *r* to *l*) is (Lat.) *loquor*, I speak, and (Gr.) *logos*, a discourse. Yet another and most interesting word, *reo*, speech or language, has its exact equivalent in the Greek *rheo*. *Rheo* meant to flow swiftly; as a river-word we find it in the Rhine, Rhone, &c.; in New Zealand we find it as *re-re*, a waterfall. But there was another meaning for *rheo*, that of speaking quickly, whence came *rhema*, a discourse, and *rhetoric*, the art of speaking. From the Anglo-Saxon form, *reord*, came our English verb *to read;* so that two English words, at

least (read and rhetoric), have Maori brotherhood, through *reo*, speech.

It is important to students to notice that the (Sk.) *dahana*, to burn the dead, seems to contain forms of two Maori words—*tahu*, to set on fire (passive, *tahuna*), and *tanu*, to bury. It will be historical evidence if these words can be traced—not only as to which branch of the Aryan race they approximate to most closely, but also as to time. The Persians do not burn their dead; it was an ancient reproach to them that they cast the bodies of their dead out into the highways and open fields for the beasts to devour. At the present day the Parsees, the purest descendants of the fire-worshippers, expose their dead to be devoured by the vultures on the terrible "Towers of Silence," at Bombay. The Hindus burn their dead, but they did not always do so; it is no part of the old Aryan creed. There are beautiful burial hymns in the Vedas; let me quote one verse:—

> "Approach thou now the lap of Earth, thy mother
> The wide-extending Earth, the ever-kindly;
> A maiden soft as wool to him who comes with gifts,
> She shall protect thee from destruction's bosom.
> Open thyself, O Earth, and press not heavily;
> Be easy of access and of approach to him;
> As mother with her robe her child,
> So do thou cover him, O Earth."

It will, of course, be asked, if there are such strange coincidences in language between the modern Hindustani, Persian, &c., and the Maori, is it not likely that the Maoris have very recently left Asia. I will not reiterate the philological argument used in "The Aryan Maori" to prove how pure and ancient is the sound of the Maori letters. One good proof is that of religion: that, even in the graft-words, I have been unable to trace any reference to the Hindu Trinities, or to any distinction of caste, &c. There was no kingly institution; they were governed by the patriarchal elders of families, and men who had gained nobility as leaders in war. I have traced their word "*ariki*" in every Aryan tongue. In Gaelic it is *ardrigh*, high king; in Old Slavonic, *zary*; in Greek *arke*, chief, *archon*, a chief magistrate; in English, *arch*-angel, archdeacon (*arke-diaconos*), from the Greek. But to the Maori it did not mean so much; it meant a chief with some authority of deity, some spiritual essence not to be described except in many words.

Next, the Maoris had not learnt to kiss—the Hindus certainly know. The word "kiss" is very interesting by this new light on Maori etymology. The Sanscrit is *kuch*, a kiss; the Maori has got *kuku*, to pinch, nip (they pinch gently as a caress), and Williams's Dictionary gives as an example of *ku-ku*, "*Te kuku o tona manawa*—that which had fastened on her affections." Another Sanscrit word for kiss is "*niksh*," but this has such a

suspicious relation to *nas*, the nose (Fr., *nez*), that I believe the Maori nose-rubbing was what "*niksh*" meant originally.

The Maoris knew of no musical stringed instruments. The Hindu word *tar*, a string of a musical instrument (whence, guitar), is represented by (M.) *tau*, a string, a rope; but the music-meaning of *tau* was a song.

The New Zealanders not only do not seem to know the later Indian deities, but they do not know their demons. The Hindu *bhut* or *bhat*, a goblin dwelling in holes and graves, may have connection with (M.) *patu-paiarehe*, the Maori fairies (perhaps *paiarehe* is the Persian word *peri*, a fairy), but it is closely allied to *puta*, a hole; the Persian *ghoul*, a demon haunting graves, also being found in *koro-puta*, a hole—*ghoul*-word and *bhut*-word together—but the hole had as yet no ghostly habitant.

The Aryans had not learnt to discriminate (in words) between colours, when the Maoris left. The Sanscrit word *gaura*, yellow, really means shining, splendid; from *gaura* the Europeans named their metal gold—but (as *ghar*) it became the root of green. The Maoris kept the original word: *k* is older than *g*; *kura* older than *gaura*, but it was preserved by them as "red;" in fact, it is not any particular tint; *kura* is our own English word "colour."

Next, they had not learnt to drink *kava*. I think this a very important addition to my argument used in "The Aryan Maori," that the South Sea Aryans came as a little later wave of migration than the New Zealander. Almost everyone knows what *kava* is—the leaves of a tree chewed into pulp, and spat out into a vessel for use as an intoxicating beverage; it is much indulged in in the South Seas. But everyone is not aware that *kava* was anciently drunk in India as a sacred potation, and under the idea that the drunkenness was inspiration—hence the Sanscrit word for a poet is *kavi*, divinely inspirited, "in a fine frenzy rolling." There was enmity between the Kahvasakha, the kava-drinker, and those who drank the Soma, the later holy beverage of India.

But if we wish to find the meaning of *kava* we must go back to "cow" again. In Sanscrit, the genitive case of *gau*, the cow, is *gavas* (once *kau*, *kavas*), and *kava* means "chewing the cud." In a book called "South Sea Bubbles," whose titled author described the preparation of kava, he says that the pretty girls sitting around the *kava* bowl did not "*chew*," they did it so prettily that it should be called "*ruminate*." That is precisely the case, the word comes from that ruminating animal, the cow.

As an instance of cattle words in Maori, I will notice that the original meaning of *kowae*, cleft, divided, is *ko-wae*, "cow's foot," the cloven hoof. This, too, was once the meaning of the Sanscrit word *gabha*, split, divided; it was *ga-pad*, cow's foot.

But the main point against the late arrival of the Maoris from Asia is that many of their words have more direct connection with the Aryans of Europe, and even of the West of Europe, than with those of Asia. The Maori word *wai*, for water, is close to Sanscrit *var*, water, but closer far to the Celtic *wy*, water. Chambers's Ety. Dic. states that Celtic *wy*, water, is the word found in the rivers Wye, Conway, Medway, &c. The Maori *awa*, a river, is the Celtic *avon*, a river, (as the Avon, &c.,) and is exactly the Gothic *ahwa*, a river. If that most unlikely thing should have taken place, that, amid a multitude of sounds to be chosen, two races on opposite sides of the world selected the same two syllables to represent water, is it by chance that the Maori *tutei*, a spy, is the Greek *teuthen*, a spy? I can find no Asiatic resemblance yet so close to the Maori *ringa*, the hand and arm, as the Lithuanian *ranka*, the hand, and (Manx) *clingan*, the arm. The Maori *moana*, the sea, at first seems far from the Latin *mare*, the French *mer*, &c., but directly we know that the Celtic *mor* is the sea, we recognise the sister words *mo*, (*mo-ana*) *mor*, (Eng.) *mere*, (Lat.) *mare*, &c. This is proved by the word "island," *motu*. *Tu* means to stand, *mo-tu* is "standing in the sea." (A clump of trees is *motu*, from resemblance to an island.) We have the word in our own Aryan tongue: a *moated* grange is a house isolated, surrounded by water—(M.) *mote*, water. What is the real meaning of *Mo*? The wet? The tossing? I believe it means the Immense, the Great sea, another meaning to the Celtic *mor* or *mhor*, being big, huge. So if the original meaning of sea was "great" (*mo-ana* or *moa-na*), it may account for our huge extinct bird being called Moa, the great one.

I had long thought that the Maori word *ika*, a fish, a monster, also meant an island; that Te-ika-a-Maui, the fish of Maui, (the North Island of New Zealand,) really meant Maui's Island, but finding that our word island was originally *ig-land* (Anglo-Saxon *ig*, Scottish, *inch*,) I am led to believe that the story of Maui pulling up the big fish has only been made to accommodate a forgotten meaning of the old word.

I said in the "Aryan Maori" that I believed the Maoris once knew the pig by a name resembling "*porcus*," and one of the graft-words used was "*poka-poka*, making holes." The Latins had exactly the same word: *porca* means a sow, *porca* a ploughed field; originally, rooted up. *Rona*, our "woman in the moon" is the Latin deity *Luna*, the moon.

An important item in the comparison of languages is that of numerals. I shall not be able to go fully into the question of the great beauty and antiquity of the Maori figures; an evening would be taken up entirely by this one subject. I will only deal with a few of them. The Maori *rua*, two, is the (Lat.) *duo*, (Eng.) two, &c. *Toro*, three, is the Aryan three. *Wha*, four, (pronounced like "fa,") is the Teutonic *vier*, the English *four*.

The five, *rima*, is the old primitive way of counting on the fingers. *Tahi, rua, toru, wha, ringa!*—One, two, three, four, hand! *Ringa* and *rima*, (or rather *linga* and *lima*) are used in the Malay Archipelago as interchangeable words for hand. *Tekau*, the Maori ten, is the Greek *deka*, Welsh *deg;* and we see the change into the Teutonic form in another Maori word *tingahuru*, ten. *Tekau* and *tingahuru* are merely changes from *ng* to *k*, just as the Teutonic form *ten* changed into Greek *deka*. In numerals the manner of counting the twenties, thirties, &c., is important: here the Maori is again Aryan, and has one very close English resemblance. The English forty is made from *vier*, four; *tig*, ten; *viertig*, forty, or four tens. The Maori *wha*, four, *tekau* ten, *wha-tekau* forty; *viertig* and *wha-tekau* being as perfect in derivation as in sound.

Through the kindness of Dr. Hutchinson I am enabled to lay before you a photograph of the statue of Kamehameha, the King of the Sandwich Islands, in his national dress. The resemblance of the whole figure to that of an ancient Greek warrior is most surprising.

I must now intreat your patience while I compare the Maori with the European languages.

ABBREVIATIONS.

(M.E.) Middle English, (Fr.) French, (O.Sl.) Old Slavonic, (Lith.) Lithuanian, (Goth.) Gothic, (Gr.) Greek, (Lat.) Latin, (Scan.) Scandinavian, (Dan.) Danish, (Celt.) Celtic, (Ir.) Irish, (Ga.) Gaelic, (W.) Welsh, (Ice.) Icelandic, (A.S.) Anglo-Saxon, (Teut.) Teutonic, (M.) Maori.

MAORI.	
Ao, the air	(Lat.) *aura*, the air, *aer*, the air
aroha, love	(Gr.) *eros*, love
ae, yes	(Goth.) *jai*, yes, (Eng.) as in "Ay, ay, Sir"
ao, the world	(Goth.) *aiws*, the world
ako, to teach, learn	(Gr.) *agora*, a debating hall
angi, light breeze *anene*, to blow gently	(Gr.) *anemos*, the wind
ara, to rise up	(Gr.) *oro*, to rouse, (Lat.) *oriri*, to rise up
au, smoke	(Gr.) *auo*, to burn
here-here, a slave	(Gr.) *helot*, a slave
huka, snow, ice	(Ice.) *jokull*, an icicle, (Ir.) *aigh*
hara, a sin	(Lat.) *erro*, to stray, err
hamuti, excrement	(M. Eng.) *mute*, to dung (O. Fr.) *mutir* and *esmeut*
humu, the hip-bone	(Eng.) *ham*, (Ger.) *hamma*
hake-hake, the itch	(Ger.) *jüchen*, to itch, (Scotch) *yuck*

MAORI.	
hine, a girl	(Gr.) *inne*, a daughter, (Russ.) *jena*
hapara, to cut, slit *haporo*, to cut off	(Russ.) *sabla*, (Eng.) *sabre*
haupu, a heap	(W.) *hob*, a projection, lump
hapu, pregnant	(Goth.) *hof*, pregnant (heaved up)
hau, dew	(Ger.) *thau*, dew
here, to tie, confined	(Lat.) *sero*, to bind
here, to confine	(Eng.) *Hell*, (Goth.) *halja*
hira, a multitude	(Goth.) *hairda*, a herd
hua, an egg	(Gr.) *oa*, eggs
ika, the fish	(Gr.) *icthys*, (Lat.) *piscis*, (A.S.) *fisc*, (Ice.) *fiskr*, (Goth.) *fisks*, (Gael.) *iasg*.
iti, little	(Ice.) *litill*
kaki, the neck, throat	(Eng.) *gorge*, the throat. Compare *gargle*, *gurgle*, (O.Fr.) *gorgias*, a ruff, &c., (Gr.) *gargale*, the neck
koro-koro, the neck	(Lat.) *collum*, the neck
kopu, the belly	(Gr.) *kolpos*, the lap, bosom
kopmo, cut off abruptly	(Gr.) *kopto*, to cut off
ko-komo, a return feast	(Gr.) *komos*, a revel
korea, a small canoe	(Gael.) *curach*, a wicker boat, (Eng.) coracle
kapo, to take, snatch	(Lat.) *capio*, to take, (Gael.) *gabh*, to take
koke, a bottle or vessel *kokini*, a bottle or vessel	(Gael.) *cog*, a bowl, (Fr.) *coche*, a small boat, (Eng.) *cock*-boat
koparu, to mash	(Lat.) *copulo*, to join together
kokeke, mussels taken from the shell	(Fr.) *coque*, a shell, (Lat.) *concha*
kamaka, a stone	(Teut.) *car*, a stone, *meare*, a mark, boundary, (O. Slav.) *kamy*, a stone
kopako, back of the head	(W.) *cop*, a head, (Dutch) *kop*, (Lat.) *caput*
kape, to pick out	(W.) *gyp*, a beak, (Gr.) *gups*, a vulture
kau-kau, a spear	(A.S.) *gar*, a spear (from the "*gore*" of a horned beast)
kopae, a basket	(A.S.) *cypa*, a basket, (Eng.) a coop
kopaki, an envelope *kopare*, to shade the eyes	(Eng.) *cope*, a covering (root of "cap")
kararehe, a quadruped	(Gr.) *gryllos*, a pig

MAORI.	
karau, a comb	(Bret.) *krib*, a comb, (Gael.) *chir*, a comb
kai, food	(Gael.) *chuid*, food, (Gr.) *kao*, to eat, *kairos*, food
kohua, to cook, boil	(Lat.) *coquo*, to cook
kaikora, a vagabond	(Gr.) *geiros*, a stranger
kata, to rejoice	(Gr.) *getheo*, to be glad
koreto, to weep	(Gr.) *goeros*, wailing, weeping, (Scotch) *greet*, to weep
korenga, soft, boggy	(Ir.) *gleanir*, (Eng.) *glen*, a narrow valley
kohine, a girl	(Goth.) *kwino*, a woman, (Eng.) *quean*, a common woman
kanapu, shining	(Gr.) *ganos*, shining
katirehe, sore throat, quinsy	(Fr.) *goitre*, from (Lat.) *guttur*, the throat
kero, to wound, maim	(Gr.) *keiro*, to cut off, (Gr.) *kedo*, to injure
kino, bad	(Gr.) *kaunos*, bad
kiri, the skin	(Gr.) *chroi*, (dat.) the skin, (Fr.) *cuir*, leather
komau, to keep fire alight	(Gr.) *kauma*, flame
koru, coiled	(Gr.) *guros*, curved, round
kuao, young of animals	(Gr.) *kuo*, to be with young
karanga, to call	(Norwegian) *kalla*, (Eng.) call and clang
kau-ruki, smoke	(Dutch) *rook*, smoke, (Ger.) *rauch*, (Scottish) *reek*
muku, to wipe	(Ice.) *myki*, (Dan.) *mog*, (Eng.) *muck*, (Lat.) *mucus*
maia, brave, bold *maiangi*, raised up	(Goth.) *magan*, might, power
mangai, the mouth	(Fr.) *manger*, to eat, (Eng.) *munch*, to eat
mutu, to mutilate	(Lat.) *mutilo*, (Eng.) *mutilate*
mutu, to cut off short	(Eng.) *mute*, a person with the end of his tongue cut off
maunga, a mountain	(Lat.) *mons*, a mountain, (Gael.) *monadh*, (Eng.) *mound*
mene, to be assembled	(Lat.) *minare*, to drive cattle
monaroa, loitering	(Lat.) *mora*, to delay
maire, a song	(Gr.) *melos*, a song
momona, fat	(Goth.) *mammo*, flesh
moe, to sleep	(Gr.) *muo*, to close the eyes, *moimuao*, to close the eyes
mote, water	(Gr.) *mou*, water
maimoa, object of affection	(Gr.) *maimao*, to desire earnestly

MAORI.	
ngarara, a lizard	(Sk.) *naga*, a snake, (Gael.) *nathair*, a snake, (Goth.) *nadr*
ngou-ngou, to knot the hair	(Lat.) *gnodus*, a knot
noho, to dwell	(Gr.) *naio*, to dwell
hiore, the tail (*whiore*)	(Gr.) *oura*, the tail
ope, a troop, company	(Gr.) *obe*, a tribe
peka, branch of a stream	(Teut.) *beck*, a brook
piki, to climb	(Fr.) *pic*, a hill-top, (Eng.) *peak*, (Ger.) *spitz*
pai, good	(Celt.) *bain*, good, (Scotch) *bonny*, (Lat.) *bonus*
po-rangi, mad	(Sp.) *bobo*, a fool, (O. Fr.) *bobu*, stupid. Last part of word probably from same root as de-*ranged*
po-rotiti, a disc	(Lat.) *rota*, a wheel, (Eng.) *rotate*
piri, close	(Eng.) *peer*, to look closely, from (Ger.) *piren*, to draw the eye-lids close
puruhi, a flea	(Rus.) *blocha*, (Dut.) *bloo*, (Ger.) *floh*
pere, to throw away, cast	(Lat.) *pello*, to drive away, (Eng.) to dis-*pel*
pipi, the young (as of birds)	(Gr.) *pippos*, a young bird, (Lat.) *pipare*, to peep, chirp
peka-peka, a bat	(Dan.) *bakke*, a bat, (Scotch) *bakke*
pori, the tribe	(Gr.) *polus*, the people, (Lat.) *po-pulus*
patiti, a hatchet	(O. Ger.) *parta*, and *barte*, an axe, (Eng.) *partisan* and *hal-berd*
pikau, to carry on the back	(A.S.) *bæc*, the back, and pick-a-back
panui, to proclaim	(Teut.) *ban*, a proclamation
patu, to beat	(Lat.) *batuo*, I beat, (Celt.) *bat*
pouto, to cut off	(Lat.) *puto*, to cut off, (Eng.) *am-putate*
pirangi, to love	(Gr.) *philo*, to love
poka, a hole	(Fr.) *poche*, a pocket, (O. Eng.) *poke*, a pocket, (Celt.) *bac*
puta, a hole	(Lat.) *puteus*, a well
pare, to ward off	(Lat.) *paro*, to ward off, (Eng.) *parry*
pane, the head	(W.) *pen*, the head
purena, to run over	(Lat.) *plenus*, full, (Gr.) *pleos*

MAORI.	
puna, a spring	(Scotch) *burn*, a stream, (Goth.) *brunna*, a spring
purakau, old man, old legend	(Gr.) *palaios*, ancient
pie, to call *pihe*, a song over the slain	(O. Slav.) *pye*, to sing
pine and *pipine*, close together	(Gr.) *bineo*, to unite
porohe, to gather in loops	(Gr.) *bolos*, to cast a net
pononga, a slave	(Gr.) *poneo*, to labour
reti, to ensnare	(Lat.) *rete*, a net
rau, a leaf	(Ger.) *laub*, a leaf
rawhi, to seize *rawe*, to snatch	(O.E.) *ravin*, to obtain by violence *raven*, a greedy bird
reke-reke, the heel	(Gr.) *lax*, the heel
rupe, to shake	(Gael.) *rub*, (W.) *rhwbio*, to rub, grind
ruaki, to vomit	(A.S.) *hræcan*, to vomit, (Ice.) *hrækja*, (Eng.) *retch*
rere, a waterfall	(Gr.) *rheo*, to flow as a torrent
roi, a tear	(O.H. Ger.) *ruz*, to weep, (Eng.) *rue*, to be sorry
ropa, a servant, slave	(O. Slav.) *rabo*, a servant
riki, little	(A.S.) *ling*, little
tia, frequent	(Gr.) *detha*, often
tiro, to look, survey	(Gr.) *delos*, apparent, manifest
tini, very many	(Gr.) *den*, a long time
tika, just, right	(Gr.) *dike*, just, right
tapau, a mat to lie on *tapaki*, mats	(Fr.) *tapis*, a carpet (Gr.) *tapes*, carpet
tinei, confused, unsettled	(Gr.) *dine*, a whirlpool, eddy
tatara, a rough mat	(Ice.) *tetur*, a torn garment, (Eng.) tatter
torohe, a marauding party	(Gr.) *dolops*, one who lies in wait
Tote, the god of sudden death *toto*, bloody	(Ger.) *todt*, dead
taureka-reka, a slave	(Gr.) *doulos*, a slave, (Celt.) *drugaire*, a drudge
tarehu, a goblin, fairy	(Scan.) *troll*, a goblin
taruke, a trap	(Ger.) *trugen*, to deceive
whaki-tauki, a proverb	(Goth.) *tuggu*, the tongue
tango, to take, handle	(Lat.) *tango*, to touch, handle, (Goth.) *tekan*, to touch, take
tahu, to burn	(Gr.) *daos*, a torch
tahei, divided by a strip *tahuna*, furrowed	(Gr.) *daio*, to divide
toro-papa, to lie flat	(Lat.) *dor* (root of *dormio*), to sleep; cf. *dorsum*, the back

MAORI.	
tako, the gums, palate	(Gr.) *dakos*, a biting
tae, to be overcome *tai-apu*, to storm, assault	(Gr.) *dae*, a battle
takakau, the forearm (comp. of "cow" and "finger")	(Gr.) *daktulon*, the finger
tamau, to fasten *tamoe*, to repress	(Goth.) *tamjan*, to tame (Gr.) *damao*, to tame, subdue
tau, to lie at rest	(Gr.) *dauo*, to sleep
taitea, fearful, timid *taiatea*, nervous	(Gr.) *deido*, to fear
tae, exudation	(Gr.) *deisa*, moisture
ua, to rain	(Gr.) *huein*, to rain
ura, brown, (from *pura*, fire)	(Eng.) brown, from (A.S.) *brun*, from *byrnan*, to burn, from (Gr.) *pur*, fire.

But it is to our own language that Maori shows some of the strangest resemblances. The Teutonic roots of the English speech have close approximation to Maori. Here are some of the most curious. The (M.) *tokari*, to cut off, or notch, is our word, *dock*, to cut short, (W.) *tociaw*, to cut short. The (M.) *rara*, to roar, is *roar*. The (M.) *patu*, to beat, and *patu* a weapon, is (Eng.) *beat*, (root A.S. *bat*) and *bat*, as a cricket bat. (M.) *toi*, the toe, *is* toe. (M.) *poka*, to thrust, *is* (Eng.) poke. (M.) *karapiti*, to grapple, *is* grapple. (M.) *taka*, a thread, is (Eng.) to *tack* with a thread; (M.) *taka*, to turn, to veer, is (Eng.) tack, to go about; (M.) *takai*, to wind round and round, is (Eng.) tangle; (M.) *tangai*, the bark, is (Eng.) tan, (for dyeing,) and tannin. (M.) *hau*, to chop, is (Eng.) hew. (M.) *hopu-hopu*, to catch frequently, is (Eng.) hobble, a leg-fastening. (M.) *hiteki*, to hop, is (Eng.) hitch, to move by jerks. (M.) *hoanga*, a whetstone, is (Eng.) hone. (M.) *hoto*, a spade, is (Eng.) hoe. (M.) *hape*, bent, is (Eng.) hoop. (M.) *hake*, crooked, bent, is the (Eng.) hook. (M.) *hakui*, an old woman, (Eng.) hag. (M.) *hae*, to hate, is (Fr.) *häir*, and (Eng.) hate. (M.) *hoko*, to sell, is (Eng.) hawker, one who sells. (M.) *hoe*, to row, (Eng.) hoy, a boat. (M.) *hua*, to call, (Eng.) hue and cry. (M.) *tae*, to dye, *is* dye. (M.) *kiri*, the hide, is (Eng.) *curry*, to dress hides. (M.) *tope*, to cut off, is (Eng.) to *top*, as to top shoots of plants. (M.) *koripi*, to cut, is (Eng.) clip. (M.) *tapahi*, chapped or chopped, is (Eng.) chapped or chopped—the (M.) *tapa-tapahi*, cut in pieces, is only *chop-choppy*. The (M.) *kuri*, the dog (once a cattle-dog), is the Scotch *cooley* or *collie*, the cattle-dog. I only cease from fear of too utterly wearying you with examples, but hundreds of words, in both European and Asiatic Aryan languages, have similar brotherhood with Maori, and have been collected by me. These Maori words are not Anglo-Maori, they are to be found embalmed in old songs

and legends which have come down to us from days which date centuries before a European keel divided the Pacific.

Although, as I said in my introduction, I shall trespass on the ground of the geologist in the briefest manner, it would be wrong not to notice the evidence forced upon us by discoveries in New Zealand. Dr. Von Haast, F.R.S., says, in an article on the Moa-hunters, in which he judges from the polished stone implements found in the caves with the broken Moa bones, that the men who hunted the Moa lived ages ago: "Of course it is impossible to calculate this time by even hundreds of years, but as polished stone implements have been found in New Zealand buried in littoral beds, 15 feet below the surface, in undisturbed ground over which extensive forests are growing, containing trees of enormous size, there is no doubt that the use of polished stone implements dates far back in pre-historic times; I mean to say, to a period to which even the most obscure traditions of the aborigines do not reach." Mr. McKay, of the Geological Department, writing on the same subject, says: "Thus we are led to suppose that a people, prior to the advent of the present stock, were the exterminators of the Moa, always accepting as incontrovertible that the immigration alluded to did not take place 1,000 years earlier than stated in the said traditions on the subject. But in the meantime, accepting the 350 years, and treating 1,350 as a wild notion which the science of the subject has never yet dreamed of, let us see if the 350 years will be sufficient for the accomplishment of all that of necessity must be performed by these immigrants and their descendants." Another branch of science, Philology, will not, I feel assured, treat the early advent of the Maori as a "wild notion"; the trouble has been occasioned by the too great credence given by Maori scholars to the value of oral genealogies, &c. Sir George Grey has kindly allowed me to quote his authority for the following statement. He for years has believed that the Maoris must have inhabited New Zealand much longer than has been stated, the 350 years giving no possible space of time in which the enormous fortifications, &c., could have been erected, and the country populated densely in the North Island—in many cases, huge trees requiring centuries to gain their present bulk having grown out of the deserted defences. On leaving New Zealand for Africa, he took his Polynesian experiences of legend, &c., and compared them with those of other primitive races, such as the Kaffirs, Hottentots, &c., and came to the conclusion that the human memory did not retain legendary *personality* beyond the tenth or twelfth generation—that after the grandfather, the fourth, the fifth, the sixth ancestor, the *Man* was getting very shadowy, that back to the twelfth they were into myth, the *Man* had gone; in myth-land they could remember and sail away grandly, and even make no mistakes, in comparison with

mythical personages of other tribes. Speaking of skeletons found in the Moa caves, &c., Dr. Von Haast notices that they were all buried in a crouching position. It will be interesting to read a few instances of comparison with the Maori usages (known to us all) that occur in the work "Early Man in Britain," describing the Neolithic men. "The dead were buried in these tombs as they died, in a contracted or crouching posture. . . . For purposes of defence, they constructed camps, with well-engineered ramparts either of stone or earth, and fosses, sometimes as many as three or four ramparts being formed one above the other. The ramparts probably bore palisades. . . . The intercourse between the Neolithic tribes was greatly facilitated by the use of canoes, formed of the trunks of large trees, hollowed partly by the action of fire, and partly by the axe, and propelled by means of a broad paddle. . . . A flint arrow-head two inches long, and a 'wooden sword' have also been met with in the peat close by. . . . This kind of traffic is proved to have extended over enormous distances in the Neolithic age by the distribution of the axes made of nephrite or jade, a material as yet unknown in its native state in Britain or the Continent."

With these quotations, I conclude.

So many matters of interest grow up as one proceeds, so many paths are seen along which one would like to tread, that my great difficulty, in this article, has been to compress without leaving some important matter unnoticed. Many offers of kindly help are being made to me, and I feel sure that, before many years have passed, we shall, by study of this subject, have added to the scientific information of mankind, and written an interesting chapter in the history of the Colony.

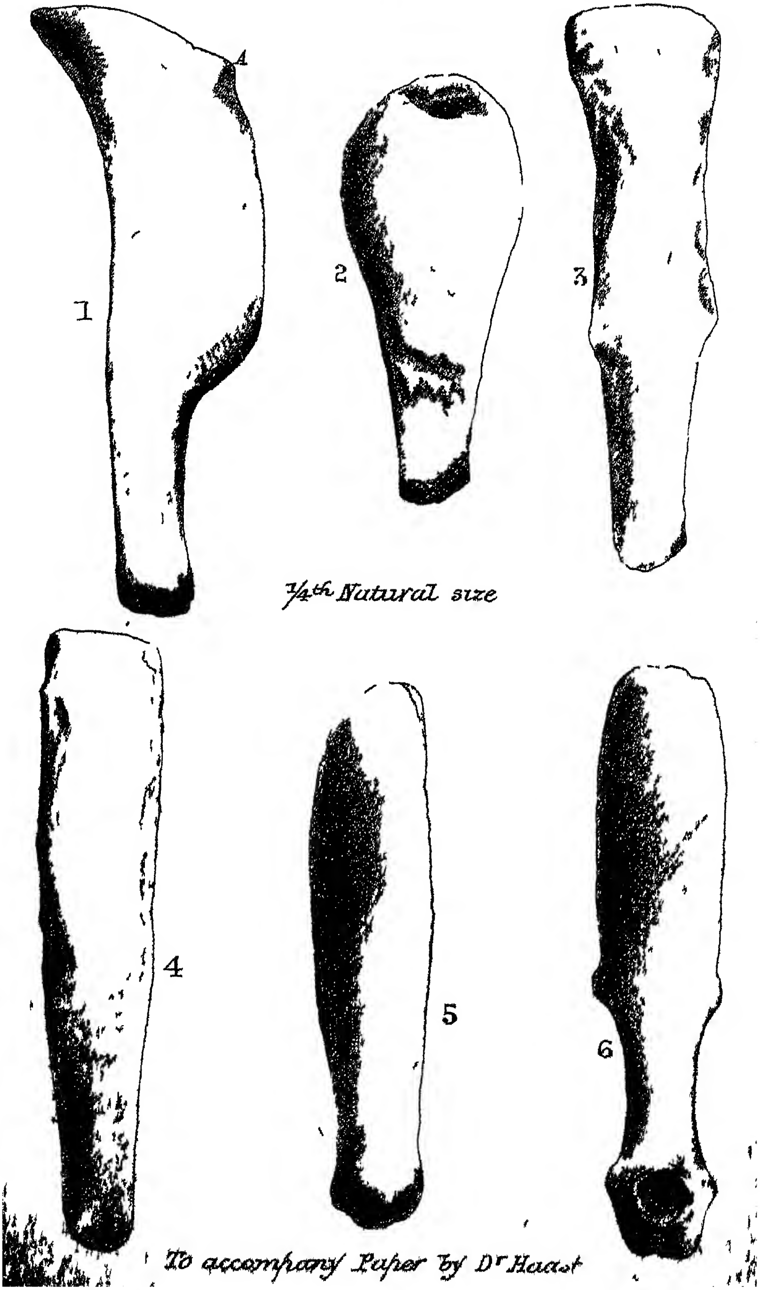
Art. II.—*On the Stone Weapons of the Moriori and the Maori.*

By Professor Julius von Haast, C.M.G., Ph.D., F.R.S.

[*Read before the Philosophical Institute of Canterbury, 26th November, 1885.*]

Plates I. and II.

For some time past I have been waiting in vain for some one more conversant with the history of the Morioris, those ancient inhabitants of the Chatham Islands, to describe fully their habits and customs, to note down their folk-lore, going back many generations, but chiefly to delineate the remains of their ancient handicraft preserved to us in burial places and spots where their dwellings were formerly situated. I was particularly anxious to have some account of those curious stone implements, known to us under the name of "*patu.*"



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To accompany Paper by Dr Haast

Though the Canterbury Museum, owing to the liberality of Mr. E. R. Chudleigh and other friends from the Chatham Islands, possesses a fine series of these remarkable stone clubs, I should not have ventured to offer any remarks upon them, had I not lately received two unique stone weapons, found near the Hinds and near Oamaru, which (as I shall show in the sequel) have, in their primitive mode of workmanship and peculiar forms, some affinity with the "*patus*" of the Chatham islanders. Wishing to obtain as reliable an account as possible of the knowledge possessed by the Morioris of the present day of the method of manufacture and use of these remarkable stone weapons, I addressed myself to Mr. A. Shand, at present temporarily residing in New Zealand, for many years a settler in the Chatham Islands. He has the reputation of being not only a close observer, but also as one well acquainted with the history and traditions of the Morioris. That gentleman, in a letter dated Auckland, 30th September, has most obligingly given me a series of interesting notes which have afforded me an excellent insight into the whole subject. I think I can do no better than give at full length the contents of his letter in this communication. As to the names of the stone weapons and axes of the Morioris, and the mode of making them, Mr. Shand states that "*toki*" is the general term for all stone axes, including the lesser kind "*toki paneke*," and chisel, "*whao*" or "*puru-puru*," all of which were used for a considerable time after the discovery of the island by Captain Broughton, Nov. 23rd, 1791, in fact, until the advent of the Europeans (Sydney sealers and whalers), about 1830 and 1836, when all stone implements were laid aside or thrown away.

The stone axes and other implements were first roughed out by fracturing and chipping with other ones until the approximate shape was obtained. I may here add that the stone implements are made of lydian stone, aphanite, dioritic and basaltic rocks, for the greater part doubtless obtained on the Chatham Islands, though there are some specimens in the Canterbury Museum, received from that locality, of chert and of some other material which appear to have been imported from New Zealand.

After the approximate shape had been given to these stone axes, the Morioris used grindstones, "*hoanga.*" These were made of a coarse sandstone, generally found on the sea coast at various places. They had generally a flat surface, were otherwise somewhat round, and varied in size from 7 inches to 12 inches on the average. This "*hoanga*" was placed flat on the ground, and the implement ground by rubbing it to and fro thereon with water. Numbers of these "*hoangas*" are to be seen at the islands, easily recognisable by the hollow in the centre, shaped like a saucer, a sign of their frequent use. Mr.

Shand observes that he need scarcely remark that the operation was tedious in the extreme; and one can easily see that such was the case by the examples of ill-ground axes, especially some of the smaller ones with round shoulders, "*uma*," unreduced, like an ill-ground European axe. On the other hand, however, there were a number of really beautifully finished axes, "*toki*," that must have taken an infinite amount of time and skill to get into such a perfect shape.

There are many unfinished axes lying about at the Chathams in the rough state, evidently intended to be ground, but afterwards thrown away. When not using them, the owner generally hid his "*tokis*" to avoid their being stolen. Now and again a number so buried are discovered in ploughing, or in digging up old places of residence. Mr. Shand observes that he has never seen, in fact doubts the existence of, any of the "*toki-titaha*" or large axes used by the Maoris, and common also to New Guinea, used for chopping the top and bottom edges of a cut, the ordinary form being used to cut out the chip by chipping sideways like an adze. It may be of interest, Mr. Shand continues, to state that the mode of making and tying a handle on to the "*toki*" or large stone axe was identical with that of the Maoris, of which race the Chatham islanders evidently formed a part in the original departure from Hawaiki. This is shown also by their traditions, legends, and the causes assigned for their leaving their so-called Hawaiki home.

The Morioris also used flint "*mata*," which they split into thin, irregular, wedge-like shapes, as knives, there being no volcanic glass ("*tuhua*") obtainable in any quantity, although a reef of it is known to exist under water at the south-east corner of the island at Manukau. The micaceous clay-slates or argillaceous schists, with layers of quartz, occurring on the northern coast of the main island—of which specimens were first brought to New Zealand by Mr. H. H. Travers in 1868, and which I described in Vol. I. of the Transactions*—were used for making the "*patus*," and were also employed in the same way as the "*mata*" (flint), though their edges cannot be made so sharp as that of the latter. Both are used with or without handles in cutting up grampus or any other variety of whale for food, the blubber of which was considered a great relish by the Morioris.

Entering upon the main subject of these notes, it appears that the Morioris, doubtless after looking in vain all over the island for a suitable material for the manufacture of their war weapons, which would take a fine polish, were at last compelled to have recourse to the argillaceous schist before referred to, to which the small layer of quartz, interlaminated with the argil-

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* "Trans. N.Z. Inst.," vol. i., p. 128.

laceous layers, gave a considerable degree of hardness. From the traditions attached to these remarkable weapons, it is evident that a long time must have elapsed since they were manufactured, and some of them brought to such perfection, considering the material from which they were shaped.

It is clear that the same process of polishing the uniformly hard material, from which the Morioris made their "*tokis*" or stone axes, could not be applied to these war-clubs, and that the principal work of forming them consisted in the chipping process. When the proposed form was thus obtained, they proceeded to give the war-clubs some little polish, as much as was possible without removing the loose argillaceous or micaceous matter between the quartz layers. In some instances the layers were so very thin and intimately blended with the rest, that a far greater polish could be given to the material worked upon. In describing the different forms of their war-clubs, I shall return to this subject. Besides the large weapons made of nephrite (greenstone) to which exclusively the Maoris apply the term "*mere*," they also used stone weapons of similar form, manufactured from melaphyre, aphanite, and other fine-grained basic rocks, for which weapons the generic term "*okewa*" was used.

The Morioris, on the other hand, who did not possess any nephrite weapons or implements, had several names for the peculiar stone weapons they at one time used for offensive and defensive purposes.

They restricted the term "*okewa*" to a peculiar bill-hook shaped war-club, of which No. 1 is a reduced representation. These okewas range from 12 inches to 16 inches in length, with a breadth of 3½ inches to 4½ inches, and a thickness in the centre of an inch to an inch and a half. The weapon figured No. 1 is a remarkably well-worked specimen 15 inches long, 4 inches broad, and 1¼ inches thick; it is worked to as sharp a rounded edge as the nature of the material would allow. In this instance the micaceous schist is of a more uniform character, the quartz layers being very thin and inconspicuous. I may draw your attention to the sharp prominence at *A*, by which the edge is divided into two unequal parts, the upper portion above it sloping more rapidly backwards. We possess some of these *okewas* in the Canterbury Museum, which are only six inches long. They were either children's toys or attempts towards the learning of the manufacture of these implements. A second form (No. 2) has the shape of a club. It is named "*pohatu taharua*." The specimen is 10½ inches long, 4½ inches broad, and 1½ inches thick. The quartzose layers are much thicker, so that less finish could be given to it. Both sides are flat, the edges only being rounded off, except at the handle, where on one side the material has been so far removed that the curvature goes over the whole surface.

It is not nearly so well finished as the *okewa*, but it may be possible either that the owner of this stone weapon was not such an accomplished workman, or that the same attention was not bestowed upon any other form as upon the bill-hook shaped one, which, according to all appearance, was the most esteemed form.

We possess another specimen of this shape, about the same size, of which one side is perfectly flat, being formed of a quartz layer, whilst the other or rounded portion, owing to the thickness of the quartz layers, could only be partially finished. There are two other forms of the same material to which the term "*pohatu taharua*" is also to be applied. No. 3 is 14 inches long, 4 inches broad at the upper end, $2\frac{3}{4}$ inches in the middle, and $3\frac{1}{4}$ inches at the lower end of the shaft above the handle. It will thus be seen that towards the middle it curves inwards, and thus has a form different from any other, as it possesses four projecting points. It is flat and rather thin, having only a thickness of 1·1 inches at its thickest part. There is no attempt made to polish it except at the handle. It has altogether an unfinished appearance. No. 4, also a "*pohatu taharua*," resembles the foregoing form in shape, with this exception—that for the first 5 inches it is of nearly the same breadth, and only gradually diminishes in breadth till the handle is reached. It has, therefore, no prominent points. It is $15\frac{1}{2}$ inches long, 3 inches broad, and $\frac{3}{4}$ of an inch thick. The blade, as in the foregoing, is quite flat, being the natural division plane of the schist. Both edges are roughly chipped, but both the upper edge and the handle have received some slight polish, or perhaps, more correctly, have been rubbed down.

It appears that the term "*patu*" (to kill) was applied only to the *okewas*; in fact, Mr. Shand is convinced that it is very doubtful if it is a correct term at all, but rather one adopted by Europeans and retained as a term generally understood, being chiefly used in a descriptive sense.

According to Mr. Shand: "Manslaying was prohibited generations back, in the time and by the command of their ancestor Numuku and others, shortly after the arrival of their ancestors in their canoes Rangimata, Rangihona, and Oropuke, the last being commanded by Moe a Rauru, whose *hapu* or *iwi* were former antagonists of the people of the other canoes, and who found their way to the island some time after them. They fought on the island, and it was ordered by Numuku and others that fighting and manslaying should cease for ever; that in all future quarrels (a long pole, '*tupururi*,' about 8 feet to 10 feet long being used) the first blow causing blood to flow, if even by a slight abrasion of the skin, was to end the fight. This, however, did not prevent the person so injured from returning in like manner and seeking satisfaction at some other time for his

bleeding head, cracked skull, or barked skin, as the case might be."

As by the genealogy of the Morioris they have existed twenty-seven or twenty-eight generations on the island, it must have been a very long time ago that by that law of their ancestor Numuku all weapons such as *okewas*, *taos* (or spears), &c., were laid aside, the latter being placed on rests at their sacred places of sepulture. *Tuahu* were only produced on the occasion of "*tohinga tamariki*," a sort of baptismal ceremony; hence the making of *okewas* fell into desuetude, and that of any other warlike weapons known to their ancestors.

Concerning the stone implements used by the Maoris and their ancestors, I have already stated that they called all those made of nephrite (greenstone) *mere*, and the rest *okewa*. It is evident that the stone clubs, possessing the same form as the *mere* but made of hard black igneous rocks, are of a far more ancient date, though they have been worked with great care, and their form and polish are perfect. They have been found in such positions that there can be no doubt as to their great age. I was therefore much interested in obtaining two Maori stone implements, which are very different in form from those just alluded to, and which in many respects agree far more with the stone weapons of the Morioris than with those of the Maoris.

One of these, found during the draining of an extensive swamp at the Hinds, and presented to the Canterbury Museum by Mr. E. H. Dobson, is roughly made of greyish dolerite rock. It is 13½ inches long, 3 inches broad, and 1¼ inches thick in the centre. It has a resemblance to the *okewa* of the Morioris, in so far that only one side (different from the form of the *mere*) has been prepared for striking by being brought to a sharp edge, and that it has no hole through the handle for the purpose of passing a strap to be fastened to the wrist. The handle is also of a very primitive character. The process pursued in its manufacture appears to me identical with that of the Morioris, the implement being first chipped and afterwards roughly ground down, though at one spot an attempt has been made to give it a more perfect polish. This is the only weapon of the kind, viz., possessing a striking edge on one side only, that I have ever seen in New Zealand; and the position of the swamp, of enormous extent, is such that it may have been deposited therein during many generations past.

Another stone implement of very great interest to the ethnologist is one that was lately presented to the Canterbury Museum by Dr. de Lautour of Oamaru. It was obtained in deep ploughing at Windermere, on the Kakanui River, near Maheno, Oamaru. It is made of a similar micaceous schist to that of which the *okewa* (No. 1) of the Morioris is manufactured,

a schist which is a not uncommon rock in New Zealand. At the first glance we are struck not only by the peculiar form but also by the mode of manufacture, as it has been rubbed down in the same manner, and has thus the same somewhat flaky appearance, as the Chatham Islands weapons. What distinguishes it from the form of the *mere* are the prominent points above the handle, so that in this respect it resembles the weapon No. 3 from the Chatham Islands. Similar prominences also occur below the handle. Here a hole has been bored for the passing of a wrist-fastener. However, the whole weapon is very imperfect as to form and workmanship, and may also date back to a time when the manufacture of these weapons was in its infancy. The following are the dimensions of this remarkable stone weapon: Total length, 14½ inches; greatest breadth, 3½ inches; at prominent points above handle, 3¼ inches; greatest thickness, 1¼ inches.

Until further specimens of the same material and form are found of these remarkable New Zealand stone weapons, it would be premature to speculate upon the affinities between them and the stone weapons of the Morioris; but it seems evident to me that they date back to a time anterior to the discovery of nephrite at the West Coast, and its subsequent use in the manufacture of *meres*, which must have supplanted the inferior material used till that time.

Art. III.—*Notes on the Difference in Food Plants now used by Civilized Man as compared with those used in Prehistoric Times.*

By W. T. L. Travers, F.L.S.

[*Read before the Wellington Philosophical Society, 29th July*, 1885.]

There has been a good deal of learned discussion as to whether man was originally destined for a vegetarian or not, but however interesting this question may be in connection with his descent, it is one of no importance now in relation to his food, because his existing structure not only enables, but practically requires, him to extend his choice, in that respect, to the animal as well as to the vegetable kingdom. And he can, as a rule, do this with especial advantage, for by using a mixed diet he not only economises physiological labour, but also saves his excretory organs from a large amount of profitless work which would otherwise be thrown upon them.

But although a choice of food is thus given to him, the varying circumstances under which he exists on earth, determine, to a considerable extent, the direction in which that choice should be made. Within the tropics, for example, where any large consumption of flesh food would inevitably produce injurious

results, man is almost exclusively frugiverous, drawing nearly all he requires for food, as well as for shelter and clothing, from the plants which spring up in profusion around him. On the other hand, in the inhospitable circumpolar regions, (although the Esquimaux eats with relish the half-digested moss which he finds in the stomach of the reindeer,) he is compelled to counteract the rigour of the climate by a large consumption of flesh food, and especially of such as is rich in carbon.

We find, however, that independently of mere climatal considerations, in localities in which the conditions are such as to admit of vigorous plant growth, the extent to which man carries the utilisation of plant life for food and otherwise varies much, but that it certainly increases in direct ratio with his ascent in the scale of civilization; and it is my chief object in this paper to show the progress which has taken place in plant cultivation, during the gradual rise of man in civilization in those parts of Western Europe in which that subject has been investigated: because, in the first place, it is from thence that we have obtained the greater part of the plants, whether used for food or otherwise, which are cultivated amongst us; and because, in the next place, the climatal conditions which now obtain there bear a close resemblance to those of our Islands.

The earliest rude inhabitants of Western Europe of whom any traces have been discovered, are known as Paleolithic men. Their remains are usually found in caves and rock-shelters, associated with those of many animals now extinct, amongst which were the mammoth, the woolly rhinoceros, the reindeer, the stag, the lion, the hyæna, and the bear. Remote, however, as the period is from the present time, during which the earlier races of these ancient men existed, the remains left behind them and by their successors of that age, in the caves and rock-shelters which they inhabited, give, to use the words of Mr. Boyd Dawkins, "as vivid a picture of the human life of the period, as that revealed of Italian life in the first century by the buried cities of Pompeii and Herculaneum." These old floors of human occupation contain broken bones of animals killed in the chase, mingled with rude implements, weapons of bone and unpolished stone, and charcoal and burnt stones, which indicate the position of their hearths. And not alone do these remains point to the co-existence of man with the extinct mammalia to which I have referred, but they also afford clear evidence of the climatal conditions which obtained during the different portions of the Paleolithic period, and a clue to the characteristics of the race to which the men belonged. Mr. Boyd Dawkins, in speaking of later Paleolithic times, tells us that, in the caves which yield evidences of man's occupation, "flakes without number, rude stone-cutters, awls, lance-heads, hammers, saws made of

flint or of chert, rest *pêle-mêle* with bone needles, sculptured reindeer antlers, engraved stones, arrow-heads, harpoons and pointed bones, and with the broken remains of the animals which had been used as food—the reindeer, bison, horse, the ibex, the saiga antelope, and the musk sheep. In some cases the whole is compacted, by a calcareous cement, into a hard mass, fragments of which are to be seen in the principal museums of Europe. This strange accumulation of *débris* marks, beyond all doubt, the place where ancient hunters had feasted, and the broken bones and implements are merely the refuse cast aside. The reindeer formed by far the larger portion of the food, and must have lived in enormous herds in the centre of France. The severity of the climate at that time may be inferred by the presence of this animal, as well as by the accumulation of bones in the spots on which man had fixed his habitation. Indeed, had this not been the case, the decomposition of so much animal matter would have rendered the place uninhabitable even by the lowest savage."

These facts do indeed afford a vivid picture of the life conditions under which man existed at a time unquestionably separated from the present age by countless centuries, and that too, in parts of Europe which now sustain a rich and varied vegetation, and in which, except the horse, all the animals above referred to are now extinct and are replaced by herds of domesticated oxen and deer, by flocks of sheep and goats, and by numerous other animals maintained either for their profit or for their beauty.

It must be manifest that during this earlier period the human inhabitants could have derived as little of their nutriment from vegetable substances, as do the Esquimaux and Samoyeds of the present day, and that it is more than probable they devoured, with the same greedy relish as the former, the partly digested matter found in the stomachs of the ruminants upon the flesh of which they chiefly subsisted. Had they possessed any of the vegetable foods which, as we shall find in the sequel, were abundantly consumed by the Neolithic men by whom they were succeeded, some remnants of such food would unquestionably have been discovered amongst the *débris* of their feasts, by the scientific observers who so fully and closely examined those *débris*; and the complete absence of any such remnants, not only justifies us in assuming that they did not possess foods of the kinds referred to, but also serves to strengthen the view expressed above as to the nature of the contemporaneous climatal conditions.

A great advance in the vegetable food available for man in Western Europe is found to have taken place in Neolithic times. We have no means of estimating the length of the interval which separated even the later Paleolithic from that part of the Neolithic period to which I am about to refer, but the geological evidence alone indicates that it must have been enormous, that

evidence being supported by the fact that an extraordinary improvement had taken place in the climatal, and, indeed, in the physical conditions generally of the district in question, as indicated by the almost universal presence within it of an abundant and varied vegetation, and of a fauna analogous to that which now exists.

Our chief positive knowledge of the vegetable food resources of the Neolithic people of Western Europe has resulted from the discovery, made about thirty years ago, of the remains of the Swiss lake-dwellings, which led to those interesting investigations which have been recorded in the great work of Dr. Ferdinand Keller, President of the Antiquarian Society of Zurich.

This discovery was first brought under the notice of the Society at Zurich by Dr. Aeppli, of Ober Meilen, who reported that remains of human industry, likely to throw unexpected light on the primæval history of the earlier inhabitants of the country, had been brought to light, owing to the occurrence in the early part of that year of an unexampled drought, accompanied with such severe cold that the rivers were practically dried up. The result of this drought was to lower the water of the lake to such an extent, at a place where some reclamation works were going on, as to enable the workmen to excavate the land upon the shore immediately in front of their retaining wall, to a considerable depth below the ordinary water level. In making these excavations they found the heads of old piles *in situ*, and great numbers of stags' bones, mixed with implements and other relics of human occupation. This led to further investigations on the spot, and to similar investigations in other places, which were followed by the discovery of a large number of the settlements now known as lake-dwellings, and to the general results so elaborately detailed in Dr. Keller's great work. Great interest was at once excited amongst scientific inquirers throughout Europe, more especially as the very first settlement which was examined, namely, that of Meilen, was found to belong almost exclusively to the Neolithic age, for, with the exception of two metal objects, all the antiquities obtained there consisted of bone, iron, wood, stone or earthenware. In order that you may understand the conditions under which these antiquities have been so long preserved, I will endeavour to give you, as shortly as I can, an idea of the general structure of the lake-dwellings.

The settlement of which any assemblage of dwellings was composed was usually formed in a shallow part of the lake on the borders of which it was established. At a short distance from the shore a rectangular space was enclosed by a row of strong piles, which were often covered on the outside with wattling or hurdle work, intended either to lessen the splash of the water or to prevent injury to the piles by the impact of floating wood or of the canoes of the people. Within the inclosure thus formed,

rows of piles, generally in regular order, were driven at short distances from each other, the heads being brought to a general level with the outer boundary. Upon these piles a rough platform was constructed, often consisting of one or two layers of unbarked beams lying parallel to one another. Upon this platform rude houses were erected, the extent of the platform and the number of houses being of course regulated by the number of persons of which the settlement was composed. That portion of the platform which was within the area of each house was covered with clay mixed with gravel, firmly beaten down to form an even floor, and each house had a proper cooking-hearth. The houses appear to have been rectangular in form, their sides consisting of wattle and daub, and the roof thatched with straw or rushes. These platforms were always at some distance from the shore, with which they were connected by narrow bridges, formed also on piles. Whether the footways of these bridges were movable does not appear; but it is probable that this was the case, in order to prevent surprise on the part of an enemy desirous of attacking the settlement from the landward. It appears that all the refuse from these dwellings was thrown into the water below, through openings left in the platform for that purpose. The general conditions under which the earlier of these people appear to have lived is the more especially interesting to us, because, singularly enough, it is to the condition of the aboriginal New Zealanders, as described by Cook, that Dr. Keller compares the degree of civilization to which the inhabitants of the settlement of Meilen had apparently attained, as indicated by the remains discovered.

After extracting from "Hawkesworth's Voyages," Vol. III., page 395, a full account of the habits of life of the New Zealanders as there given, he proceeds to show the close resemblance to that account which is indicated by the remains found at Meilen and many other of the more ancient lake settlements. He then tells us, in regard to their domestic economy, (with reference particularly to the supply of vegetable food,) that in every lake-dwelling were to be found stones for bruising and grinding grain, or what are called corn-crushers and mealing-stones; that the very grain itself has been found at Meilen, Moosseedorf, and Wangen, nay, even the very loaves or cakes in their original form; and that we must therefore recognize the colonists as agriculturists, and see them advanced to that grade of civilization in which men have permanent abodes, and have secured for themselves some degree of social order. He remarks that the tilling of the ground must have been simple in the highest degree, and have consisted merely in tearing it up by means of inefficient tools made of stags' horns or crooked branches of trees, as is still done by some of the North American Indians, and was formerly done (as regards crooked pieces of wood and

other rude implements) by the Maoris ; but he points out, nevertheless, that the products obtained from this rude cultivation were generally excellent—a fact known to ourselves as regards the Maoris—because, as a rule, they always used rich virgin soil, or soil that had long lain fallow, for growing their crops in.

Dr. Keller refers us to a treatise by Professor Heer on the plants used by the Lake-dwellers, for information as to their husbandry, and it is from that treatise, and from the investigations of Alphonse de Candolle and others, that I have prepared the following *résumé* of the subject. The remains of plants, from which Professor Heer drew his conclusions, were found lying in the lake mud below the sites of the various settlements, or buried under peat, several feet thick, formed since the settlements ceased to exist. They were found mixed with stones, fragments of pottery, domestic instruments, charcoal, ashes, and other unmistakable evidences of human occupation, and consisted of remains of cereals, of weeds usually associated with cornfields, of culinary vegetables, of fruits and berries, of nuts, of oil-producing and aromatic plants, of bast and fibrous plants, of plants used for dyeing, of mosses and ferns, of fungi for kindling fire, and of water and marsh plants. Of the plants used for food the cereals were evidently the most important, and consisted of a now extinct form of wheat called the "lake-dwelling wheat," and of a small-grained six-rowed barley, also extinct; whilst the spelt (which at present is one of the most important cereals,) and the oat did not appear until the Bronze age, and rye was entirely unknown. With the exception of a pea no culinary vegetable can certainly be mentioned as belonging to this period, but a small bean and a field lentil appear during the Bronze period. As to fruits, they appear to have been possessed of an abundance of crab apples, and in the later periods of a larger but still inferior species of apple, which may have been the result of cultivation; of a small and inferior description of pear, found associated with the relics of the Bronze period; of a plum closely allied to the bullace; of sloes, bird cherries, raspberries, blackberries, and strawberries, whilst it seems that they also used the fruits of the dog-rose and elder. Beech nuts were found in large quantities, and cakes, of the seed of the garden or field-poppy and carraway seeds, occurred amongst the remains of some of the more recent settlements.

Heer and de Candolle both remark that the Lake-dwellers could not have had any close connection with the people of Eastern Europe, otherwise they would, without doubt, have cultivated rye, and that the plants actually cultivated show that their chief intercourse must have been with the people of the Mediterranean basin. Every species of corn which they used had certainly come from that quarter, for it was identical with

those cultivated in Southern Italy, whilst the millets were similar to those cultivated in Egypt.

In connection with the character of the vegetation under notice, Professor Heer points out that it affords some clue to the determination of the age of the lake-dwellings, and by means of this and other evidence bearing on the question, he came to the conclusion that, whilst the most recent of those dwellings, namely those of the Bronze period, might be not less than 2,000 years old, the oldest might date back for thousands of years before the commencement of the Christian era. He also points out that those remains, which unquestionably have a very high antiquity, throw some light on the solution of the question whether the species of plants have undergone any change in historic time. As regards the wild plants he answers the question in the negative, (a conclusion concurred in by the late Mr. Darwin, for reasons given in detail in his work hereafter referred to,) but finds that the case is different with the cultivated plants, for that the greater number of those agree with no recent forms sufficiently to allow of their being classed together. He tells us that the small Celtic bean, the pea, the small lake-dwelling barley, the Egyptian and the small lake-dwelling wheat, and the two-rowed wheat or *emmer*, form peculiar and apparently extinct races, and he adds that man must, therefore, in course of time, have produced sorts which gave a more abundant yield, and have gradually supplanted the old varieties. Mr. Darwin sums up the investigations of Heer and others in passages which are to be found at pages 318 and 319 of the first volume of his great work on "Animals and Plants under Domestication," a work which, by the way, ought to be closely studied by every breeder of animals and cultivator of the soil.

From all this it will be seen that the great advance in civilization exhibited by even the earlier Neolithic over the latest Paleolithic inhabitants of Western Europe, may be assigned chiefly to their possession of an abundant supply of vegetable food, suitable, not only for man, but also for the maintenance of domesticated animals, of which, as Professor Rütemeyer of Basle tells us, they possessed several species.

I do not propose to deal with the long period which has intervened between the occupation of the lake-dwellings and the present time, which pertains entirely to the historic period, not only because it would stretch this paper to an inconvenient length, but because we shall be able more clearly and highly to appreciate the advance made in the character of our vegetable food during this interval, by a comparison of the inferior species possessed by even the later inhabitants of the lake-dwellings, with the rich produce now found in the cultivated fields and gardens of Western Europe. This is vividly brought to our

notice if we compare the list given by Heer of the vegetable foods used by the Lake-dwellers, with any well prepared gardener's catalogue of the fruits and vegetables now available for food, a comparison which cannot fail to satisfy us how much civilized man has already benefited, and may further expect to benefit, by the application of the principle of selection to the variability so especially characteristic of vegetable life, which has been so admirably discussed by Mr. Darwin in the work above referred to.

ART. IV.—*The Building Timbers of Auckland.*

By EDWARD BARTLEY, Architect.

[*Read before the Auckland Institute, 30th November*, 1885.]

SPECIMENS OF TIMBER TO ILLUSTRATE THE PAPER.

KAURI.—Four specimens: Red, white, black, and a soft kind from Tairua.
Piece of kauri joist destroyed by dry rot.
Piece of kauri destroyed by grubs.
Piece of window-sill from St. Andrew's Church, built in 1847.

RIMU.—Piece of 12 in. x ⅝ in. board, to show the difficulty in discriminating between sap and heart.

TOTARA.—Piece with the commencement of small spots of decay.

KAHIKATEA.—Piece of flooring completely destroyed by the grub.

THERE are only four kinds of New Zealand timbers used in Auckland for building purposes. I place them in the following order of merit: Kauri, rimu, totara, and last kahikatea. After touching on these various timbers, I propose to say a few words on seasoning and decay of timber. Permit me to remark that the statements are not gathered from hearsay, but from thirty years' experience in the building trade in Auckland. I have of late years taken down buildings that I either took part in erecting or saw erected; I have had, therefore, many opportunities of studying the durability and other characteristics of our Auckland-grown timbers.

First, the kauri (*Dammara australis*).—I have here specimens of four kinds of kauri: the red, white, black, and a soft kind, quite distinct in grain and quality from the others, which I will hereafter explain. The red kauri is the best general building timber; it is well adapted for heavy framework, beams, joists, and the like; it is close-grained, rather gummy, very durable, but is liable to cast and twist; it shrinks endways as well as in width. The shrinking endways is a great drawback to kauri, and more especially this kind. I have known a forty feet beam shrink 1½ inches in length. I have also known a weatherboard shrink ¾ of an inch in twenty feet, and most of us will remember ceiling mouldings and other joiners' work

shrinking so as to quite disfigure the building. This red kauri should only be used for beams or other framework, and not for mouldings or joiners' work. The next is the white kauri, a tough kind of timber; will bear a greater breaking strain than the red, but not so durable; I have seen it quite soft in a few years; it is a splendid timber for moulding and joiners' work. The shrinking endways is almost *nil*, if worked up after a fair amount of seasoning, neither will it cast. It is largely used by boat-builders on account of its readiness to bend. Black kauri is not very abundant, it comes from the west coast of the island, it is only fit for rough work, is heavy with gum, and the most durable of all; in fact, for fencing-posts or the like, I believe it would last as long as puriri. I need hardly say it is not fit for mouldings or joiners' work; it is so hard it would require very strong machinery to work it, and after being worked it would cast into all shapes. The last specimen of kauri (No. 4) is *the* timber for joiners' work and mouldings; there is a peculiar grain marking in this kind of kauri not to be found in any of the other specimens—this kind should only be used for mouldings and joiners' work. We have often heard it remarked that kauri is noted for its casting, twisting, and shrinking: well, this last kind of kauri will neither cast, twist, nor shrink endways. I have seen slight scantlings, say 3 in. by 3 in., 20 feet long, quite straight, after being exposed to the weather without any care. I have seen joiners' work made up out of this timber standing as well as cedar. I have already said it should only be used for joiners' work and mouldings, it is so light and soft; it should never be used for beams or heavy framework; but if this kind of kauri and the white only were used for joiners' work and mouldings, we should seldom hear of ruined ceilings, and twisted doors and sashes. This kind of kauri is only found in the Tairua District.

The next timber on my list is the rimu (*Dacrydium cupressinum*). It is known in the South Island as red pine. The rimu, I believe, grows in the South to a very large tree, but in this province the average size tree is two feet six inches to three feet diameter; it is a timber with a large proportion of sap-wood—a two-feet diameter log will have nine inches of sap-wood, leaving only six inches of heart, the heart not being very well defined. By this specimen of rimu (a board twelve inches wide) the difficulty in discriminating between sap and heart will be seen, even by an expert. There is a hard white gum, and frequently many shakes, near the heart, that renders this tree unfit for boards, but it answers well for scantlings, joists, and framework. The sap-wood, if exposed to weather or damp, will not last, but the heart is very durable. I have known rimu fences standing many years. Of course, with kauri so plentiful, we have not used much rimu; but at the rate the kauri is being cut, before many years we shall, I am sure, have to fall back on

the rimu. Picked heart of rimu is a very good furniture wood, and very suitable for church furniture.

Totara (*Podocarpus totara*) is the third timber of importance. It is largely used in the South for building purposes, but in Auckland we only know it as a good "pile" timber, and for that purpose it has not been equalled by either native or imported timbers. I have seen a "stringer" taken from Queen-street Wharf quite sound, after being under water twenty-eight years. Of course it was heart, the sap will not last; hence the folly of using round sticks for piles. All piles should be squared timber—all heart. It is at times specified for plates and window sills, with a view, I presume, that it will last longer than kauri. I think this is a mistake: my experience is that it will not last as long as the heart of red kauri. There is a small "rot" speck found in the heart of mature trees; I have here a specimen cut from a new plank with this kind of decay, still the totara must be classed as one of our most durable timbers.

The last, and the worst of our building timbers, is the kahikatea (*Podocarpus dacrydioides*). It will decay very soon, exposed to the weather or damp—in damp situations it will not certainly last longer than four years—and inside, or under cover, such as flooring, ceiling or lining, it is attacked by a small grub, completely destroying the inside of the scantling or board. I have here a specimen of kahikatea flooring destroyed by this grub; the destruction is so complete that I have known a floor rendered dangerous to walk on, the chairs having gone through in many places. I consider kahikatea is far inferior to all sap kauri. If used for rough lining, the perforations made by this grub will appear through scrim and paper of the room; in an instance that came under my notice, one kahikatea board had been fixed for rough lining, the remainder being sappy kauri: the board, scrim, and paper were quite destroyed, like a band nine inches wide, the remaining lining being quite sound. It is said that kahikatea grown on high ground grows better than that grown on low ground; but the greater portion, I should say nine-tenths, grows on flat swampy districts.

Seasoning and Decay of Timber.

The causes of decay are various, the worst being "dry rot"—a term giving a wrong idea of the nature or cause of the decay. I have here a specimen of heart kauri destroyed by "dry rot." It is covered with a fungus of extraordinary growth in Auckland. I have seen a plant measuring over five feet in diameter. Whether the fungus grows in consequence of the decay, or the decay is caused by the fungus, I am not quite clear; but I should rather think the fungus grows after the decay, and is not the cause of the decay. At any rate we know the first cause is by using unseasoned timber in unventilated positions, such as a

ground-floor without a space left for ventilation. Nearly if not all the ground-floors on the east side of Lower Queen-street are decaying with "dry rot." I have known 12 in. x 3 in. all heart kauri joists quite rotten in twelve years; the joists will break off in pieces from six inches to two or three feet long, and will be found flat on the ground, with square ends, the timber always breaking at right angles to the fibre of the wood. The kauri is also destroyed by a small grub, similar in some respects to the grub in the kahikatea, but with this difference: the grub in the kahikatea always bores with the fibre of the wood; the grub in the kauri will bore in any direction. I have here a sample of kauri bored with this grub. The sap-wood will be attacked first; but if found in a building, it will soon go right through, heart and sap falling a prey to it.

One great reason for kauri and other timber decaying is the constant use of young and unmatured timber. A mature kauri will be at least five feet diameter, showing well defined sap-wood of not more than three to four inches. Now, a large quantity of logs cut up in Auckland will not measure more than 2 feet 6 inches to 3 feet in diameter: this size log will have nine inches of sap-wood, leaving on a log 2 feet 6 inches only 12 inches of heart, and that soft and white. Next to using young timber is the constant use of unseasoned timber, and the practice of our mill-owners cutting down trees all the year round, and full of sap. I consider the trees should be "barked" at least six months before being fallen; the barking, of course, simply means cutting out a ring of bark, say four or six inches in width, close to the ground. Another plan, adopted in America, is to bore two holes right through the trunk, crossing each other in the middle of the tree; either or both are inexpensive operations, and should be tried by the mill-owners. As to the time of year for falling our New Zealand timbers, I consider, if barked or bored as I suggest, it would not matter a great deal. It will be seen at once that if we get rid of the sap or gum before falling we have overcome half the difficulty (if not more) experienced in seasoning. Hence the failure of artificial seasoning by the hot chamber, used a short time ago by some of the mills, the hot chamber simply baking the outside, leaving the sap and gum inside the plank. It is a fact known to all carpenters that kauri will season better in the rain and wind of winter than the hot sun of summer. Most of us know the effect of new kauri shingles on a tank of water: the gum and sap is washed out to such an extent by the rain, that the first water off the roof is like weak turpentine, and dark in colour. Then we have another cause of decay, consequent upon using unseasoned timber, that is the injudicious use of tar. It is right to tar a well-seasoned piece of timber, but utter folly to tar green timber, and all round, as we see repeatedly done in our buildings and wharves. I have known

a 4in. x 3in. plate of heart of kauri quite rotten in two years, solely on account of being tarred all round; the proof being that other plates in similar situations, and quite near, were quite sound. If the durability of timber is to be studied, it should be a rule not to paint or tar timber before being seasoned. That kauri will last, I have had many instances brought under my notice. Here is a portion of a window-sill taken from St. Andrew's Church, built in 1847; it will be found not the least impaired by thirty-six years' exposure to the weather. It was removed about two years ago. It was resting on a stone sill; the under side, it will be observed, has not been painted. Only one other instance: The two first grave fences in the Auckland Cemetery, erected thirty-three years ago, are still standing, and quite sound. The posts are of red kauri, and had been charred.

ART. V.—*A Description of the New Volcano in the Friendly Islands, near Tongatabu.*

By the Rev. S. W. BAKER, Premier of Tonga.

[*Read before the Auckland Institute, 30th November*, 1885.]

ON Sunday, October 11th, a slight shock of earthquake was felt about 10 a.m., and seeing we had had several shocks lately no particular notice was taken of it; but on Tuesday morning everybody's attention was directed to vast clouds of steam and smoke which were arising from the sea in a N.N.W. direction. On the preceding evening, at 11 p.m., many natives and others saw a vivid flash of light, and heard a report like thunder in the direction of the Huga Group of islands. On the matter being communicated to His Majesty, it was determined that the *Sandfly* should be sent to ascertain the bearings and extent of the volcano. Accordingly at noon the *Sandfly* left the Port of Nukualofa, having on board the Rev. S. W. Baker, the Premier, wife, and family; the Rev. J. B. Watkin and son, Dr. Buckland, and several other gentlemen; the Chief Tugi and several natives.

As the *Sandfly* neared the spot the scene was most magnificent, great volumes of steam, of carbonic and sulphurous gas, &c., being shot forth from many jets out of the sea, in a direct line of over two miles, extending in a northerly direction, to the height of 1,000 feet and more, then expanding themselves in all directions, in clouds of dazzling whiteness, and assuming the most fantastic shapes; sometimes presenting themselves as a mountain of wool, the tips of which were fringed with gold, caused by the rays of the setting sun, then again occasionally forming into a large cauliflower head of snowy whiteness,

backed by clouds of intense darkness formed of dust and ashes mixed with watery vapour, which the wind was carrying down for miles on the distant horizon. As the heavier matter kept continually falling, it gradually raised in height the new-made island; and as the cloud of pulverulent matter became thinner and thinner at its extremities, it assumed a light brown colour, forming clouds of volcanic dust which, no doubt, would be carried thousands of miles away, and repeat (if the theory be a correct one) the red sunsets of the volcanic action of last year in distant parts of the Pacific: and, strange to say, on the third and fourth evenings after the bursting out of the volcano, the same red sunsets as were seen last year were again noticed. The size of this mass of volcanic matter was immense; at one time it could not have been less than some thousands of feet at its base, and, piercing into the air to a great height, was distinctly seen thousands of feet above the clouds, and at one time a streak of sable colour passing across its centre made the whole mass present a most picturesque and grand sight. This great mass of accumulated gas, steam, and volcanic substance, was continually augmented by fresh explosions, bursting forth from three large and a number of minor jets. These jets, and especially the largest one, would suddenly rise forth like a solid wall of dark matter, in shape something similar to the three fingers of a man's hand, but always of a more or less conical form, and at times bearing a striking resemblance to the *Pinus pinaster* and *Pinus sylvester*, thus forcibly calling to mind the historical stone-pine of Pliny the Younger, mentioned in his letter to his friend, the historian Tacitus, in connection with the eruption of Mount Vesuvius in A.D. 79. The black clouds were small at first, and only appeared at considerable intervals, and gradually became larger and more frequent, 1½ to 3½ minutes expiring between each eruption, but still retaining their perpendicular character; and, after rising to a considerable height, their sides would sometimes fall quickly into the sea, causing clouds of steam to arise, whilst the centre would topple over and form itself into clouds of white gaseous and vapourous matter, presenting itself like a huge bunch of Prince of Wales' feathers; and what was most singular, many of these dark cauliflower eruptions had a spiral movement, always turning in the same direction from north round by the west to the south, and right against the wind. As the shades of evening approached and the night came on, the matter discharged by the volcano no longer appeared a huge mass of clouds of snowy whiteness but in the form of clouds of greyish matter and sooty blackness. We were somewhat disappointed in there being no signs of fire; many watched during a great part of the night, anxious to catch the first glimpse of the lurid flame, but were doomed to disappointment.

As the first light of morning appeared, we commenced to approach near the grand scenery of Nature's last wonder, having kept during the night at a distance of seven or eight miles. As daylight appeared, it was soon evident that the volcano had lost none of its activity, but instead of there being so many jets as on the previous night, several of them at the southern end of the line of jets had coalesced and formed themselves into one immense submarine chasm, and the rays of the rising sun shone upon the mass of vapoury matter and made it appear most beautifully golden. Having a good breeze behind us, we ventured to approach nearer than we would have otherwise done, and we were duly rewarded for our trouble, for we found that an island had already been formed some three to four miles in length, one in width, and attaining a height of about 40 feet at its highest part, which was around the crater on the N.W. side, and gradually shelving away from this until it lost itself in the sea. The length of the island was probably increased by a black mass, which we believe to be floating pumiceous matter ; and it was also seen that a reef extended from it in a N.E. direction, from the surface of which various jets of steam were arising. The eruptions were now very rapid, and in one instance there were no less than four huge eruptions in three minutes. Although one of these large masses was ejected considerably over 1,000 feet, yet it only took 16 seconds in reaching that height; in fact, having timed many of the eruptions, we found that notwithstanding they went to a greater or less height they invariably took from 12 to 16 seconds. Some of these eruptions must have contained hundreds of tons of matter ; and several times, just as the eruption reached its height, great spouts would be seen, which appeared to be huge waterspouts, and continued increasing until they were lost in the mass of gaseous vapour. These eruptions continued with very little interruption until 8.30 a.m., when to the surprise of everyone they suddenly ceased—and it is worthy of note that up to this moment there had been a constant column of smoke, &c., discharged from the volcano—and the strong wind, carrying away all the clouds of steam and gaseous matter, presented to our view the whole of the land, with a distinct crater formed on the S.E. end of the same, the back part of which was considerably higher than that at the water edge, which appeared to be only a foot or two. Dr. Buckland and others were of opinion that this was the exact moment when it emerged from being a submarine volcano to that of an ordinary volcano. As we were not more than one mile from it, we had a splendid and magnificent view, and we were led to judge that the crater from the size of the base of the column was at least two miles in circumference. Our attention was drawn to a white spot which appeared on the western slope of the crater, which, after careful examination with our glasses, we concluded was a bird which had tried to fly across

the volcano, and was suffocated by its fumes. So eagerly were we examining the crater that we neglected to notice the dangerous position in which we were, for, to our surprise, the vessel, notwithstanding the breeze we had, made but little headway, and for a few minutes it looked as if the current would draw us into the volcano. However, after several minutes of suspense the breeze increased, and we were soon out of danger, which was clearly manifested by the vessel shooting ahead as she drew out of the current; and it is fortunate for us that we escaped when we did, for the volcano commenced action shortly afterwards, and fragments of heated stone were hurled aloft to a great height and then fell, together with showers of cinders, splashing into the sea at some distance from the edge of the new-formed island. The matter ejected now seemed to be of a more solid nature than that which had been previously thrown out by the volcano. This, together with the fact that very little steam was now seen around its base, although over the surface of the island the steam still continued to rise in small jets, seems to be sufficient proof of the correctness of the conjecture formed by Dr. Buckland, that it had now passed from a submarine volcano to that of a volcanic island, and although no fire presented itself, yet it continued all day belching forth such solid matter, accompanied with clouds of gases; for, after the completion of the crater, the enormous upheavals of cinders, mud, and dust, &c., increased not only in rapidity, but also in height, ten occurring in twelve minutes; sometimes a second and third would arise before the first had fallen. This continued for about three-quarters of an hour, when the eruptions became less frequent, but increasing in height, towering aloft from 8,000 to 10,000 feet, or perhaps even considerably higher, and the light flocculent clouds of vapour, which separated themselves from the main mass and floated away in the air, presented a most enchanting spectacle, and between the eruptions the island was more or less visible. But to describe the various shapes which these eruptions of gaseous matter assumed would be impossible. It certainly is one of the grandest efforts that even volcanic nature has ever made, and one of the most beautiful sights that mortal man has ever been permitted to behold. On that evening, about 7.30, the first signs of fire were visible, and all through the night at intervals it sent up quick darts of lurid light, sometimes of a burning red, and at other times a bluish or pinkish flame; the reflection on the clouds, as some large flash burst forth, presented all the features of sheet lightning, and the light always appeared in the same place, and on one occasion four or five flashes occurred at the same instant; but whether it was due to the condensed clouds of vapour being highly charged with electricity, or whether it was caused by fire being ejected from the volcano, it is difficult to determine. And

thus we were permitted to see the various forms through which it passed, from that of a submarine volcano, with its dashing boiling stream, to that of a volcanic island ejecting its heated stones, mud, cinders, &c.

This volcano forms one of the linear series of volcanoes which run in a direct line from the Culibras to Fonualei, bearing N. by E. ¼ E. and S. by W. ¼ W. magnetic.

There are no less than six volcanoes in this belt, including the recent one, and all in the Friendly Islands Group, viz.: Sandfly Rock, Tofua, Kao, Wesley Rock, Late, and Fonualei. This is the order in which they stand from the recent volcano. Of these Kao is the highest, and is 5,000 feet in height, but has not been active for many years; its crater is on the N.E. side, and the shape of the island is that of a large cone. The next in height is that of Tofua, a large razor-back island, with the crater on the N.E. side. This is 2,800 feet in height, and has been slightly in action only a few months ago. The next is Late, 1,790 feet, and is still in action. Then comes Fonualei, which in some parts is about 600 feet, but has not been active for more than thirty years. The last volcano is that of Wesley Rock, which sprang up as a submarine volcano in the year 1858, and was discovered by the *John Wesley*: it is now about 400 feet, and occasionally very active. It is somewhat singular, and perhaps worthy of notice, that the mouth of all the craters of these volcanoes has an easterly aspect. But whether the present volcano has burst out on a part of the Culibras reef we are not prepared at present to say, the Culibras reef being marked on our chart more to the S.W. And a circumstance of considerable interest in connection with the Culibras reef is that it has fallen and risen several times during the last few years: at times a long reef being distinctly visible above the water, and at other times not a trace of it to be found; such is the statement of authorities who went with the express purpose of ascertaining and locating its position; and on one occasion, after the lapse of a year or so, the reef was found to have shifted a distance of no less than three miles. The position of the present volcano is N.N.W. from Nukualofa, 48 miles; from Huga Tonga, N.N.W. ¼ W., 14 miles; from Huga Haapai, N. by W. ¾ W., 15 miles; and its latitude and longitude, from bearings taken on board the *Sandfly* while abreast of the volcano, are: Latitude, 20° 21′ S.; longitude, 175° 23′ W.

Since writing the above account, Captain Lane, of the *Maile*, who visited the volcano thirty-two hours after we left it, states that in his opinion the volcanic action is dying out, that the upheavals are becoming in a marked manner less in height, that the largest he saw was only about 5,000 feet high, and that the island did not appear much more than a mile in length; but others of his ship's crew give two and a-half to three and a-half

miles as its length. The captain also states that the island is now fully 150 feet high. But yesterday and to-day (October 19th) the volcano, as seen from Nukualofa, is again as active if not more so than ever.

The difficulty of putting on paper anything like a correct idea of this grand sight will be fully admitted by every lover of science, but we trust that this short description will enable some who were not permitted to be with us to form some idea of this magnificent spectacle of our latest volcanic eruption.

Art. VI.—*The Maori Language, with Remarks on the Reform of English Spelling.*

By James Coutts Crawford, F.G.S.

[*Read before the Wellington Philosophical Society, 21st October, 1885.*]

Prefatory.

I use, for illustration, the vowels as generally pronounced in Italian, German, Spanish, excluding the French modifications. In a reform of the English alphabet it is difficult to say how to express the sound of the English *e*, the Continental *i*. This latter vowel is so much used in English, in such words as *tin*, *sin*, &c., that it would be difficult to establish as *e*, and therefore, perhaps, the German *ie* will be preferable for the purpose.

I use the German diphthongs *au*, *ai*, *ei*, *iu*. Italian, I think, has no diphthongs, the vowels in that language are all pronounced separately. I have used *ae* to represent the English *a*, as in *fate*. This is perhaps non-phonetic, but it is in accordance with Teutonic usage; *a* has always the broad sound, as in *man*.

I have used *ao* to represent the English *aw*, as in *law*, but I am inclined to think that it would be better to adopt for this purpose what appears to be the Dutch plan, viz., *aa*.

It is sometimes inconvenient to use the German *ie* to represent the English *e*, as for instance, in Scripture names. In those cases I have retained *i* alone.

It is a matter for congratulation that, whoever reduced the Maori tongue into a written language, has avoided the absurd attempt to adopt it to English vowel sounds, and has adopted the Continental vowel system and pronunciation. The Maori language has, in consequence, assumed a form and appearance of structure and of culture which would have been lost had the English system prevailed, and the result is, that the moment a

word in the language is seen, its pronunciation is at once apparent.

If we compare this system with that which was formerly in vogue when English orthography was applied to the names of persons and places in India, native names in Australia, and also in America, we may perceive at a glance the advantages gained by the practice adopted with reference to the Maori language.

In reading most books upon India, it is almost impossible for a person uninitiated in the native tongues to tell the sounds of the native names and designations. Thus we find the two chief tribes of Afghanistan described as the Barukzye and the Suddozye. When spelt Barukzai and Suddozai the pronunciation is obvious, but as they stand in the previous orthography there is an uncertainty about the sound, inasmuch as the letter *y* is pronounced in English in several different ways. The name of the kingdom of Oude is almost invariably pronounced wrongly by outsiders, as the spelling and the pronunciation are so inconsistent. One of the most irritating words, to my mind, in this orthography is *sepoy*, which is a barbarous corruption of *sipahi*, a foot soldier. In the English form the word has a ludicrous appearance.*

The other day, in an Indian work of merit, I came across the words *gui hye*; now who can tell, except he is told by an expert, what to make of this? Pronounce the words to a Maori, and he would at once write down *kuai hai*, about the sound of which there would be no mistake. *Brandee pawnee low*, a sentence which formerly was much heard in India, looks barbarous enough; a Maori would put it down as *Parani paoni lau*, which looks civilized.

The orthography of native names in Australia has similar defects to those above described in India, chiefly caused by making the letter *i* stand for the diphthong *ai*. Thus we find *Koraio* spelt *Corio; Bulai, Bulli; Molongulai, Molongulli; Merai, Merri.* This blunder is not constant, however, for we find Gundagai spelt correctly.

In Fiji, and at the Cape of Good Hope, we find fanciful spelling. In the former we find *c* represents *th*, and *o* stands for *om*. Thus *Thakombau* is spelt *Cacobau*. In South Africa we find *Ketchwayo* spelt *Cetewayo; Etchowe, Ekowe.* This style is provoking, as apparently meant to puzzle people, without sense or reason. The result is that these names are generally pronounced wrongly.

One peculiarity the English have is in vulgarizing names. The King *Kaofi Kalkali*, of Ashanti, is reduced to *Coffee Calcalee*, although his name has doubtless nothing to do with coffee; the

*A corrected official orthography for India has been issued, but many do not use it.

corn fodder of South Africa is spelt *mealies*, although not ground into meal, and *milis* would be the correct term. Various plants pass under the name of *tea* tree, including the *ti* (*Cordyline australis*) of New Zealand. The name of the old town of Aymouth is changed to Eyemouth, and Tung we find as Tongue. The euphonious name of the Pass of Branda is changed into *Brander*, giving one a suspicion of cooking. The names of the Irish towns, Tallogh and Mallogh, are changed into Tallow and Mallow from the dropping of the gutteral; but why not *Tallo* and *Mallo*. The *w* is of no use, but vulgarises the names by suggesting common articles. In Stanley's work, "How I found Livingstone," I find the word *Seedy* for *Sidi*, the name of a very useful tribe of negroes, many of the race being employed as firemen in the P. and O. steamers. There is no reason to suppose that they are of drunken habits, but the English spelling conveys that idea.

It was curious at the time of the war in Afghanistan to see the puzzle of the London newspapers, as to the spelling the name of the ruler of that State. His right name being Shir Ali, had been Frenchified into Shere Ali; and when a fort had to be named after him, instead of reverting to the correct name of Shir, they made the name Sherpur, "the town or fort of Shir Ali." A man must be very vowel deaf indeed who cannot see that this must alter the whole sound of the word.

Various attempts are now being made to reform the orthography of the English language by the Americans, and by the Spelling Reform Association and others in England.

In neither case are the results scientific or satisfactory.

The Americans seem to think that the main point to be attained lies in shortening the words, by omitting unnecessary consonants; the English by stereotyping existing sounds.

The English and American ears have become in a manner deaf to the true value of the vowel sounds, and require preliminary instruction before undertaking the reform.

Thus, by the American plan, by leaving out one *l* in such words as *spelling*, *shilling*, *willing*, &c., we should soon, with the defective ear, get to the following changes in pronunciation, viz:—*speling*, *spieling*; *shilling*, *shailing*; *willing*, *wailing*. Another American change is spelling *plough* as *plow*, which is non-phonetic and objectionable; *ow* is a barbarous way of rendering what can be better done by *au*; besides which it is discredited for the purpose, as we have *bow* = *bau* and *bo*; *row* = *rau* and *ro*; *stow* = *sto*, &c.

So much for American innovations. The English idea seems to be to stereotype all the defective sounds at present existing, and apparently in the interests of the South of England and the Cockney dialect, ignoring the North. Thus we should soon lose the broad *a* and the sound of the letter *r*. A notable instance of

the latter is the proposal to render *father* and *farther* equally by *fadha*.

The most provoking thing in the interests of spelling reform is that men of the highest education in England are as unconscious of the defects in scientific orthography as the most ignorant of the people. Until they awake to a sense of the incongruity there is little hope of a reform in the right direction. Thus we hear *Ismailia*, *Port Said*, &c., pronounced in the French fashion, which is altogether wrong, either with reference to the diphthong or to the Arabic name. We have *Aeden* for *Aden*, *Gaol* for *Point-de-Galle*, *Aethos* for *Athos*. We may hear *Mehemet Ali* called *Mihimet Aelai;* although, strange to say, *Pacha* is not yet converted into *Paechae*. We find *Lima* called *Laima ; Rio*, *Raio ;* and even *Panama*, *Paenaema*. Lately I heard a learned archdeacon, who had travelled in the East, talk of *Baeaelbec*, unconscious that the double *a* should give an extra breadth to the sound.

At the time of the Crimean war, we used to hear of *Bisaika Bay* for *Besika Bay*, *Skiuterai* for *Scutari*, &c. On one occasion on returning from Lake Taupo, a well-known New Zealand statesman, an M.A. of Oxon, in a conversation we had together respecting the interior of the island, insisted on giving the French sound to the word Taupo, as if *au* represented the same sound as *awe* in English. I objected. He said, "I pronounce it as spelt, and I object to the foreign spelling of the Maori language." I replied, "How then would you spell Taupo in English fashion?" He said "*Towpo*." My reply was, "That would in English make the word sound *Topo*, although a Scotchman might probably hit upon the correct pronunciation."

A Saturday Reviewer lately objected to the spelling of *Hawaii*, preferring Captain Cook's orthography of *Owhyhee*. There is no accounting for taste; but the Hawaian language has been brought into a phonetic orthography, and Hawaii is the name of the island, and of the kingdom, which Owhyhee as usually pronounced is not; but if we accent Ōwhȳhēe thus, we arrive very nearly at the sound of Hawaii.

The reasons why English orthography is so irregular are sufficiently obvious :—

1. The peculiar sounds given to the vowels in the English alphabet.

2. The adoption of a peculiar mode of pronouncing Latin, and also of Scripture names.

3. The introduction of a number of French words into the language, which are sometimes pronounced in French, in others in English, fashion.

4. The small attention which is paid in England to the study of other foreign languages than French.

The first-named reason has probably been the cause of all the rest. The child is taught that *a* = *ae;* no broad *a* is taught.

e = *i*, or German *ie*.

i is a diphthong = *ai*.

o, as in other European languages; but in practice has several sounds.

u, also a diphthong = *iu*.

y = *uai*.

Thus we find three diphthongs represented by *i*, *u*, and *y*; three diphthongs in six letters. No other European language, that I know of, represents diphthongs by vowels. It is unfortunate that the broad *a* is not represented in the English alphabet, the child being taught that *a* = *ae;* the consequence is that in these days of education *ae* is rapidly taking the place of *a*. I lately heard a newsboy in London calling "*Staendard*." I find *bass* (fish), in the West of England called *baess*. At a meeting of a scientific society, I heard *basalt* called *baesaolt*. I was almost tempted to ask whether the lecturer was talking about bay-salt. It is a curious fact that when the letter *a* appears twice in an English word it is rarely pronounced the same way in both instances. One letter is *a*, the other *ae:* as in *passage*, *passaege; facilitate*, *facilitaete*. Often the change goes in the other direction. Thus we hear *Garibaldi* called *Garibaoldi; Gibraltar*, *Gibraoltar; Malta*, *Maolta; malt*, *maolt; halt*, *haolt*.

The introduction of French sounds into a Teutonic language has made great mischief. These in question are non-phonetic, and unsuited to the character of the English language. Thus, in French we have *mais* = *mes*, *tais* = *tes;* and we have introduced the same sound into English, as in *tail*, which to adapt to Teutonic spelling we should write *tael; tailor*, *taelor; nail*, *nael; sail*, *sael*.

Then *au* in French is sometimes equal to *o*, and at others to *ao:* as *Pau* = *Po*, *mauvais* = *movè*, *maure* = *maor*. We find the latter sound in English in *Paul*, *maul*, *haul*, &c.; whereas, phonetically, we ought to employ *au* to stand for such words as *ow* in *how*, and so accommodate to Teutonic spelling.

On the other hand, we have such French words as *invite*, *divide*, to which we have given English sounds. How to deal with them is one of the most puzzling things in spelling reform. If the spelling is altered phonetically, it takes the word away from its derivation; and the question is, whether a change back to the French sound can be brought about.

Then we have from the French the words ending in *tion*, such as *attention*, *promotion*. The French sound of *tion* is peculiar, something between *sion* and *siong*. The English shorten this into *shun*, which hideous termination the spelling reformers propose to adopt. I am inclined to say with Lord Melbourne,

"Can't you let it alone;" but if a change is to be made, I would suggest *sion*. The admixture of French words has been most damaging to the reform of English orthography.

The English mode of pronouncing Scriptural names no doubt has come about from the mode of pronouncing Latin. It is melancholy to see the loss of euphony which is brought about by this plan. I call to mind the archdeacon, with *ore rotundo* giving out the text from *Aisaiah*, without the smallest conception that *i* and *ai* should have a different sound. When I hear Hebrew words pronounced from the pulpit in English style the effect on my mind is neither sacred nor solemn, but, on the contrary, ludicrous. When I hear Sinai called *Sainaeai*, the effect passes the ludicrous, and the speaker seems silly. It is surely too bad to burlesque sacred things from the pulpit. There would really be no difficulty in bringing about a correct pronunciation of Scripture names. Forty years ago every one in church responded *Aemen*. The High Church decided upon *Amen*, and it has carried the day.

The spelling reformers would retain the present absurd pronunciation of Scripture names and alter the spelling. Thus Isaac is to be changed to *Eisak;* it should more properly be *Aisak*. Abraham is to become *Aebraham*.

If anyone cannot see the loss of force and of cadence which the English pronunciation of Scripture names involves, he must be very deficient in perception.

It is astonishing what small attention is given in England to the study of the Teutonic languages in comparison with that devoted to French. No doubt more attention has of late been given to the study of German, but few know anything of Dutch or Danish, languages closely related to English. I do not remember ever meeting an Englishman who spoke Dutch, except my own father, and he learnt it almost accidentally when commanding a frigate for several years off Java and in the Eastern Archipelago. I would strongly recommend every spelling reformer to read up Dutch and Danish, as well as German, and then he would see the correct lines to go upon.

I think it was Huxley who told the parsons to read up biology before he would take the trouble to argue with them. An English spelling reformer must remain thoroughly incompetent until he has obtained some knowledge of the other Teutonic languages.

Great uncertainty of pronunciation is caused by the use of the letter *y*, it having in English two different sounds. In the Scandinavian languages it seems to represent the sound of the English *e*, the *y grec*, and therefore we get an idea of how Danish names in England such as Whitby, Appleby, &c., should be pronounced. As pronounced in English there is a loss of euphony. Thus if we take the name of an island in the Eastern

Archipelago commonly spelt by the English *Bally*, and substitute for this *Bali*, we gain much in euphony. We might apply this to *Balimahon* for *Ballymahon*, *Balishannon* for *Ballyshannon*, &c. The use of *y* as representing the diphthong *ai* or *uai* ought to be abolished.

The change to a correct pronunciation of Latin is sometimes opposed, because people cannot decide upon the Latin pronunciation of the consonants, cannot settle whether or not *Cicero* is to be called *Sisero* or *Kikero*, Cæsar or *Kaisar*. Probably, like the Italians, the Romans pronounced *c* soft before *e* and *i*, and hard before the other vowels. Thus *Kaisar* would be correct, and *Kikero* wrong. Now this is matter of comparatively little consequence, and might be left alone; but no doubt the English do make a mess of the consonants as well as of the vowels. Thus, in German we hear them call *Schwalbach*, *Swalback*, *Schlangenbad*, *Slangenbad*; and when the tourists go to the Highlands in autumn what a burlesque they make of the Celtic names!

The effect of the degradation of the letter *a* to the inferior sound of *ae* is to eliminate the basso sounds from the language, and the result is similar to that which would be produced in an opera if all the basso sounds were omitted.

The tendency also to reduce the sound of *r* to a minimum, particularly in the South of England, diminishes the force of the language. Thus, what must a Roman think when an Englishman calls him a *womaeno*, with a faint approach to a roll in the middle of the *w*? Or imagine an Englishman in the days of Lord Palmerston proclaiming himself, in the English fashion, "*Saivis womaenus sum!*" The force of the expression has evaporated in the feeble and effeminate pronunciation.

For the sake of force, also, it may be regretted that the English have dropped all the strong gutturals, as in such words as *light*, *might*, which still retain their old sounds in broad Scotch. With regard to the word *height*, the Americans give us an excellent illustration of a step in the wrong direction by changing the spelling to *hight*, thereby converting a diphthong into a vowel. Instead of this they ought to change *might*, *right*, &c., into *meight*, *reight*. The *gh* in these words are now of no use, but they do no harm, and serve to show where the gutturals once existed.

I must confess to a liking for strong gutturals. What force there is in such words as *Junta*, *Xeres*, *Ojos*, in Spanish, where the *j* and the *x* have the sound of the Scotch or German *ch*; or, in Arabic, of *Hassan*, *Achmet*, *Bahr*, *Mahmoud*, wherein the *h* is pronounced as a very deep guttural. How much force Spanish gains over its sister language, Italian, from which gutterals have been entirely eliminated.

Many tourists may remember John Campbell, who drove the coach from Loch Goil Head to St. Catherine's, in Loch

Fyne, and who kept his passengers in roars of laughter during the journey, chiefly from imitations of Cockney tourists. One of his stories was of a Cockney, in affected tones, asking: "Coachman, which is the way to *Straechur*?" the *ch* pronounced soft; "*Strachūrr*, Sir, I suppose you mean."

When an Englishman is remonstrated with on his pronunciation of the name of a foreign place, he is apt to say, "Would you pronounce such names as Paris and Calais as the French do?" This shows a want of appreciation of the point. Pronouncing the *s* in Paris and Calais is quite legitimate, as bringing the names into reasonable accord with English; but if we should say *Paeris* or *Paerais*, or *Caelais*, in accordance with what is often done, the damage is evident. A single vowel ought never to be employed to express a diphthongal sound. We must not have *i* to represent *ai*, nor *u*, *iu*. In English *ew* is used to represent *iu* in *mew*, *pew*, *stew*, *new*; consequently we find this clumsy arrangement applied to *Tewfik*, which ought to be spelt *Tiufik*.

One may hear educated Englishmen say that every nation has its own way of pronouncing Latin. This, as an excuse for English pronunciation of that language, is nonsense. Each foreign nation makes some slight variation, but each has fixity within its own lines. Thus we know how an Italian pronounces *u*, and how a Frenchman modifies the sound; but it is not varied within the nation. In English Latin no one can tell how *u*, or any other vowel, is to be pronounced. The English are generally supposed to be sensitive to a sense of the ridiculous; but how an educated Englishman can venture to quote Latin in the presence of a foreigner baffles comprehension. The effect must be inexpressibly ludicrous, on the supposition that the foreigner can comprehend the utterance. Possibly he takes it for some unintelligible gibberish. The difficulty of teaching a correct pronunciation of Latin lies with the masters. I remember the attempt being made at a New Zealand College, but the false system had become so engrained in the masters that they seemed incapable of throwing it off. One of them, a graduate of Cambridge, told me that they had improved *ego* into *eggo*! Out of the frying-pan into the fire. If the masters once learnt their business there would be no difficulty with the pupils.

The Latin of any Continental nation is understood by the scholars of any other: that of the English is intelligible to none.

One point in the reform of English spelling is very important, and would tend to obviate many changes. This is, instead of altering the spelling, to revert to a correct pronunciation. Apart from such matters as the pronunciation of Scripture names, I would instance such words as *natal*, *fatal*. Instead of altering the spelling to *naetal*, *faetal*, would it not be much better to pronounce them correctly, with the broad *a*. It is

only a question of teaching the teachers. The mind of the child is a blank board, ready to take in whichever sound is given; and if the teachers knew their business, there would be no difficulty with the children.

It is much to be desired that the Americans should go hand-in-hand with the English in a reform of the spelling of the language. It will be a misfortune if the two nations diverge in their orthography. The English are more in contact with foreign nations, and therefore, in this respect, more favourably placed for effecting a reform. On the other hand the Americans have a large German population; and if they would humble themselves to admit the defect in ear, which they have in common with the English, and call in some Germans to their help, they might lead the way, and the English would be obliged to follow. They have also got Mark Twain, and if he took the matter up he would carry it to successful issue. His observations on the defects of German grammar show that he would be equally alive to those of English orthography. In the meantime the American attempts at reform are possibly mischievous, and certainly useless, and as much may be said of many of the English propositions. I would advise the Americans to spell *Ohio* and *Iowa*, as *Ohaio* and *Aiowa*. This would point to the direction in which reform should go.

The objects that should be aimed at are:—

1. The language should be thrown into gear with those of Northern, Central, and Southern Europe.

2. English, being a Teutonic language, should, as far as possible, be brought into accord with German and Dutch, as also Scandinavian.

3. As a preliminary step in the reform, the classical languages, particularly Latin, should be pronounced as in German and Italian, &c.

4. Scriptural names should be pronounced as on the Continent, and the spelling left unchanged.

And now a few remarks with regard to the deterioration of the Maori language may not be amiss. This language has been reduced to a correct orthography; but emigrants arrive from England who know nothing of it, and who have been taught Latin in the English style. They at once begin to spoil the names of places. Thus *Ti nui*, the big *ti* or cabbage tree, becomes *Tenui*, literally *the big*, which is senseless. *Pitone*, or *Pito-one*, the end of the beach, becomes *Petone*, without meaning. *Titahi*, bay, becomes *Tetai*, *Taitai*, sometimes *Teti*. *Ohiro* becomes *Ohairo*, and so on.

Apart from mispronunciation or mis-spelling of Maori, the English dialect that is developing in Australasia is not satisfactory. The tendency is to a modification of Cockney. Thus we generally hear "*I seen him*" for "*I saw him*," which is certainly

queer grammar; but sometimes this is diversified by "*I sawr 'im.*" As expletives, "*My word*" and "*No fear*" are favourites, both drawn out as long as possible. The letter *h* is frequently treated in Cockney fashion, *i.e.*, omitted where it should be pronounced, and put in where not wanted.

I have often observed in London Colonial newspapers complaints of the use of Maori names, as being unpronounceable, &c. Considering that the Maori language is softer than Italian, this shows how much the writers know of what they are writing about. I should strongly object to displace the soft, easily pronounced, and generally descriptive Maori names, by the Bellevues, Mounts Brown, or Smith, or Jones, or other names showing the poverty of the English language for nomenclature. Compare the Spanish language for this purpose. Masafuero, the name of a small island outside Juan Fernandez, means literally *more far*, or *farther off*. Expressed in English the name would never do, whereas in Spanish it is sonorous and euphonious. Similarly *Cape Cow's Tongue* will not answer, whereas *Cabo Lengua de Vaca* is euphonious and appropriate. Even in Great Britain the old Celtic names are generally the best, and have more poetic meanings than the more homely names of the Sassenach, such as Pitmuis, "the field of blood," Kilkiaran or Kilkerran, "the cell of Kiaran," &c.

The sound of the letter *s* has been very often changed in English to that of *z*, as in *is, iz; was, waz*. The spelling reformers would change all these into *z*. Cannot the original sound be reverted to? In phonetic printing the frequent occurrence of *z* looks hideous, almost as bad as *shun*.

Some persons may say, Why should we object to the French sounds in the language and prefer the Teutonic? The reply is easy: English is a Teutonic language, and although it has borrowed many words from French, it can under no circumstances be converted into a Romance language; besides the French sounds are non-phonetic—as such they do not do the same mischief in French as in English, because in the former language the sound is nearly constant, whereas in the latter it is arbitrary and variable.

Certainly the pronunciation of French words is peculiar. We find *eau, eaux, au, aux*, all = *o; beau* = *bo, peau, pôt* = *po, maux* = *mo, faux* = *fo, chateau, chato*. We adopt some of these words into English and call *beau, bo;* but *beauté* we call *biuty*. *Beauly* (firth), we call *Biuly*. Then the French call *comment, commong; vraiment, vraimong; appartient, appartieng; proportion, proporshiong; maison, maesong; bon, bong; mauvais, movae; suis, sui; es* and *est, ae; sommes, som; êtes, aet; sont, song*. This is not the language on which English orthography should be reformed. It is essentially a Latin *patois*, the rule being to cut off the final syllable of Latin, thus: *Rome* for *Roma; bon* for *bonus*,

French is the foreign language which is most taught in England. The consequence is that Englishmen suppose there is no such thing as a phonetic language. If German, Italian, and Spanish were more taught they would learn to understand the subject.

A few more peculiarities of English present themselves. *Cacao* we spell *cocoa*, and pronounce *coco*. *Bilbao* used to be, and often is still, spelt *Bilboa*. *Kakatua* we spell and pronounce *cockatoo*. The name has nothing to do with a cock; the bird may be a hen. *Kaka* is the generic name for parrot among many languages of the East, and *kakatua* is that of the particular family.

Chinchona we spell *cinchona*, and generally pronounce as if it were an Italian word. The name, if Spanish, was derived from that of the Countess Chinchon, wife of the Captain-General of Peru, and *ch* in Spanish is always soft, as it is generally in English. There is, no doubt, the authority of Linnæus for *cinchona*, but he evidently made a mistake in this name.

In the first attempt of a child to speak he says *ba*, and this whether he is of English or any other race. When the child grows up and goes to school we tell him that *a* = *ae*, and therefore that *ba* ought to be *bae*. Luckily he knows better, he has found out by instinct that *ba* is *ba*, and not *bae*. Afterwards he learns to say *papa* and *mamma*, and notwithstanding the teachings of his alphabet, he does not call them *paepae* and *maemae*. Advancing in age he speaks of his *father*, not *faether*; although, strange to say, the Scotch adopt the latter sound, contrary to their usual habit of broadening the vowel *a*.

In these days of æstheticism it is utterly impossible that the orthography of the English language can remain long in its present barbarous and almost ludicrous state, but the change to a more correct system must be brought about by real linguists and men of taste, men who thoroughly understand the Teutonic languages—not only German, but Dutch, Flemish, and the allied Scandinavian tongues. Until some result is arrived at by men of the above-named qualifications, it would be much better for both English and Americans to desist from any premature changes.

It appears to me to be a misfortune that the Teutonic name *berg*, mountain, should have been lost to the English language, except in *iceberg*, and the Romance names *mount*, *mountain*, substituted. *Mount* may generally be considered as a diminutive of *mountain*, but we find it applied to mountains of the greatest elevation. Thus we find in Mount Cook, Mount Everest, and other mountains of the first class, the name *mount* filling the position which it does in the Mounts Pleasant, or Brown, or other small elevations in the vicinity of English towns. Cookberg and Everestberg would be infinitely better. In New

Zealand we have the relative height of elevations well defined in *maunga*, mountain; *puke*, hill. Suppose we convert Mount Cook into Maungakuku, this would be much more euphonious than Mount Cook, and serve as well the purpose of commemorating the name of the great discoverer.

Mount, as a rule, is applied to a hillock; when exceptionally used to denote the highest mountains in the world the effect is feeble.

To return to a few more illustrations. The German name for *ice* is the same as our own, but they spell the word *eis*. Any one can see that the German spelling is phonetic, but what shall we say to the English *ice*. The *i* is made into the diphthong *ei*, the *c* into *s*, and the *e* is mute and useless. In the same category we have *nice*, *twice*, *rice*, *spice*, *mice*, &c. The mute *e*, at the end of words, ought to be abolished.

What must a foreigner think when he hears an educated Englishman talk of *Demostheniez* and *Pericliez*. This pronunciation has a thoroughly illiterate effect, something similar to the crier in Court calling out, "*Oyiez, Oyiez*," or of a lawyer talking about *laechiez*, or of *Naisai Praius*. The pronunciation is not even according to English custom, for we do not say *Agniez*, *businiez*, *Totniez*, *prickliez*, *wrinkliez*. When an Englishman is asked why he does not pronounce names correctly, he says that it would look like affectation to do so, whereas the affectation is all the other way.

A few illustrations will show in what a curious way the letter *o* is treated in English. We find its different and varying sounds in *tome*, *tom*, *one*, *come*, *cooper*, *coffee*. There may possibly be more variations. I have picked out the above at random.

Now all these various defects in English orthography have a strong bearing upon the future of the Maori language. That language has been brought into a phonetic orthography, and many of the European settlers understand this: but every day fresh arrivals come from England who know nothing of the subject, and who proceed to damage the Maori tongue. The culprits are to be found in the Post Office Department; as compositors in newspaper offices; as officials in the Land Office, and in the public generally. Thus we find the native names mis-spelt and made ridiculous. I have already mentioned the cases of *Petone*, for *Pito-one*, *Tenui* for *Tinui*. I may add *Kaiwarra* for *Kaiwharawhara*, *Mangahao* for *Mangāhoa*. When I traversed the Forty-mile Bush, some twenty-four years ago, I put this name down as *Mangāwha*, which is practically the same as *Mangāhoa*. *Mangahao* does not give the sound at all.

Pauatahanui is converted into *Pahautanui*. *Ohiro* is not mis-spelt, but is pronounced *Ohairo*, and so on. One could find many similar examples. But what can be expected when

the English alphabet is treated in the way in practice: when the child is taught that *a* = *ae*, and no symbol is given for the broad *a*; that *i* = *ai*; that *u* = *iu*, &c. Let the reform begin at the fountain head, by a re-arrangement of the alphabet.

One or two Scotch names give good examples of the difficulties in spelling brought about by the want of system in English orthography. Let us take the name MacNeil. We find this variously spelt McNeil and McNeal. Although apparently a Celtic name, I suspect that it came from Scandinavia, where we have to this day the frequent Christian name of *Nil*, *Nils*. The French could make nothing of Neil, so changed the spelling to Niel, in the case of the celebrated marshal. The McNeils and Neals should do the same, and the name would then be written phonetically.

We find the name Mackay spelt the same, whether the owner of it comes from the Highlands or from Galloway; but the pronunciation is different. In the former case it is *Mackai*, in the latter *Măckae*; and at San Francisco I found another variation, viz., *Mackāe*, the accent being on the last syllable.

In looking up the Scandinavian languages, I have been struck with the similarity in some respects to broad Scotch, and I suspect that the language of the old kingdom of Northumbria, extending from the Humber to the Forth, has been more influenced by Scandinavian immigrants than is generally supposed. Such words as *baru* for *bairu* are suggestive; and in Norwegian I found a sentence, viz.: "*Qua sae?*" meaning "What do you say?" which one may hear any day in the streets of Edinburgh or Glasgow.

Art. VII.—*The Non-Euclidian Geometry Vindicated: a Reply to Mr. Skey.*

By F. W. Frankland F.I.A.

[*Read before the Wellington Philosophical Society, 13th February, 1884.*]

The following observations are an abridgment of a series of letters addressed to Mr. Skey, the author of the paper entitled "Notes upon Mr. Frankland's Paper 'On the Simplest Continuous Manifoldness of two Dimensions and of Finite Extent,'" read before the Wellington Philosophical Society on 26th June, 1880, and contained on pages 100–109 of the thirteenth volume of the Transactions of the New Zealand Institute. By Mr. Skey's kindness and courtesy these letters were made available to me for the preparation of a printed reply to his criticisms. I make no apology for the form in which this reply appears. I have taken, *seriatim*, the main points which Mr. Skey raised, and replied to each of his contentions in detail. Mr. Skey's own words are in each case placed at the commencement of the

paragraph, and the number of the page from which the quotation is made is indicated. It seemed to me that in this way only could a searching and exhaustive refutation of his arguments be given.

1. What is meant by the assertion that "the axioms of geometry may be only approximately true"? (p. 100) It means that the actual physical constitution of the space in which we live may be different from the space treated of in works on solid geometry, but that it must be *so nearly* the same that we cannot detect the difference by the most delicate experimental methods at our command.

2. "The author then adverts to 'the existence' of a particular manifoldness, which has been treated by Professor Clifford in a lecture on the postulates of space" (p. 101). I mean it *exists* in the sense of being logically constructible, not in the sense that any surface in the space in which we live possesses such properties. It *may* be that planes (or *flattest surfaces*, if the expression be preferred,) in the space in which we live possess the properties of this "manifoldness." We cannot know whether they do or not. If they do, at any rate their total areas must be immensely large.

Perhaps it may be said that any absurd scheme of pseudo-geometry is "logically constructible." But this is not the case. It is not possible, for instance, to construct a scheme of geometry in which two shortest lines enclose a space (all shortest lines being supposed congruent), and in which the three angles of a triangle are always less than two right angles. Such a scheme would be logically self-contradictory. For it is logically involved in the assertion that two shortest lines may meet twice, assuming all Euclid's other axioms to be true, that the three angles of a triangle are always *greater* than two right angles. They *cannot*, under such circumstances be either equal to 180° or less than 180°.

3. "Then he describes how this space is analytically conceived, with the object of putting us in a position to apprehend certain discoveries of his own, which relate to its very singular properties" (p. 101). The manifold* I described in my paper is not a *space*. It is a manifold of *two* dimensions, not of *three*. It may be described as an unimaginable but logically constructible *surface*.

4. It is not accurate to say that Professor Clifford "imputes finiteness" to the universe or to space. He says, in common with most living mathematicians who have studied this question, that space *may* be finite—not that it *is* finite. Its possible finiteness is spoken of, not in the sense of its having a *boundary*, which would be unmeaning, but as implying that space may return into itself, so to speak, just as the surface of a sphere and

* This term is now generally used instead of the more cumbrous "manifoldness."

the circumference of a circle return into themselves. In other words, the totality of space may have a finite volume, just as the surface of a sphere has a finite area, and the circumference of a circle a finite length. As far as pure mathematics go, we cannot decide whether space is infinite or finite. *Experience* alone can decide; or, rather, although we cannot imagine any experience sufficiently extensive to prove the infinitude of space, experience may possibly some day prove its finiteness.

5. "The prime object" of the paper "is to spread and support the views of the metaphysical school." . . . . "This view is supported by the fact, that just recently this gentleman has read before us a very able and profound paper, entitled, 'Mind Stuff,' and which is evidently of a highly metaphysical character" (p. 101). The allegation here quoted is so far from being correct, that I claim for my paper on "Mind Stuff" the character of complete consistency with the experiential philosophy. It endeavours to show that the only things of which we have any direct knowledge are the feelings we ourselves experience. By a legitimate inference from experience we conclude that there is a world outside us which causes these feelings, and this world I infer to be composed of stuff ("mind stuff," Professor Clifford called it,) remotely similar to our own feelings, but not worked up into so complex a structure. If by the "metaphysical school" be meant the school which holds that we can discover truth otherwise than by experiment and observation, then it is precisely the school which the non-Euclidian geometry has done more than anything else to confute. The geometry of Euclid has hitherto been their stronghold: "Here, at least," they have hitherto said, "the human mind can, without any appeal to experiment, evolve, from its own structure, truths which hold good with absolute exactness, throughout immensity and eternity." Now, since the researches of Lobatchewsky and Gauss this can no longer be said. They and their successors have conclusively shown that, as far as logical consistency is concerned, there are an infinite number of alternative geometries, and that experience alone can decide which of these is physically true.

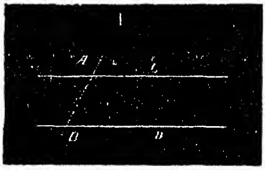
6. To the expression "geometers of the Euclidian school" (p. 101) I take exception, believing that none such are left in the sense in which Mr. Skey uses the word. The triumph of the non-Euclidian geometry, or, I will say, the "general" geometry, has been complete. I can safely appeal, on this point, to any distinguished member of any Mathematical Society in Europe or America.

7. "It is not this equivalent which Lobatchewsky is supposed to use in his attempt at demonstrating the truth of his assumption" (p. 102). Neither Lobatchewsky nor any one else has attempted to demonstrate the *truth* of the assumption, but

only to demonstrate *that no one else can demonstrate its falsity*. In other words, he has attempted to demonstrate (and that he has completely succeeded all modern mathematicians allow) that the truth of Euclid's 12th axiom can by no possible succession of syllogisms be deduced from the other axioms and the definitions of the straight line, plane, parallels, &c. Innumerable attempts had been made to do this—*i.e.*, to put the 12th axiom on the same logical footing as, for instance, the 5th proposition of the First Book. All the attempts had failed. Lobatchewsky proved, once for all, that they must necessarily fail, by constructing an unimaginable but perfectly self-consistent scheme of geometry, in which all the other axioms were assumed to be true, and all the definitions remain the same, but in which this one axiom (the 12th) was assumed to be false. The equivalents of Euclid's axiom which I have mentioned are really exact logical equivalents. If one is true, all are true. If one is false, all are false. In Euclid's space all are true: in Lobatchewsky's, all are false.

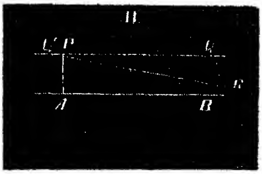
8. I propose now to establish the exact logical equivalence of the three forms of the parallel-axiom mentioned in my paper.

Form (a), (Euclid's) is:—"If a straight line meets two straight lines, so as to make the two interior angles on the same side of it taken together less than two right angles, these straight lines being continually produced shall at length meet upon that side on which are the angles which are less than two right angles." In other words, if the angle $C\,A\,B\,+$ the angle $A\,B\,D < 180°$, then $A\,C$ and $B\,D$ will at length meet.



This is Euclid's axiom, and it is to my mind just as good as any of its modern substitutes.

I now propose to deduce from this axiom the usual modern substitute:—"It is impossible to draw more than one straight line parallel to a given straight line (*i.e.*, lying in the same plane with it, but not intersecting it) through a given point outside it." Let $Q\,P\,A + P\,A\,B = 180°$. Then, by a proposition of Euclid which does *not*, directly or indirectly, rest on the 12th axiom, $P\,Q$ can never intersect $A\,B$.



Draw any straight line $P\,R$ within $Q\,P\,A$. Then,

Since $Q\,P\,A + P\,A\,B =$ two right angles

$\therefore$ $R\,P\,A + P\,A\,B <$ two right angles.

$\therefore$ $P\,R$ will eventually meet $A\,B$ (Euclid's 12th axiom), *i.e.*, $P\,R$ cannot be parallel to $A\,B$. Hence no line within $Q\,P\,A$ and passing through P can be parallel to $A\,B$.

Similiarly, no line through P and passing outside $Q\ P\ A$ can be parallel to $A\ B$, for the continuation of it would fall within the angle $Q'\ P\ A$. Hence only one straight line can be drawn through P parallel to $A\ B$, viz: $P\ Q$. $Q.E.D.$

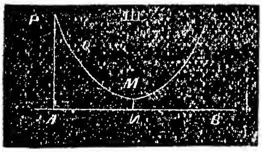
I have thus shown that if Euclid's axiom is true, then the modern substitute is true. To establish the exact logical equivalence of the two axioms, I should have to prove the converse formally, viz.: that if the modern substitute is true, then Euclid's axiom is true. But I assume it will be conceded that the above reasoning can quite well be put in the converse form. I now pass to the third equivalent, which is alleged by Mr. Skey not to be a real equivalent of the other two. If it be borne in mind that the word *parallel* in the second equivalent means *not* equidistance along the whole length of two lines; but *lying in the same plane, plus non-intersection however far produced* (see Euclid's definition)—if it be borne in mind that I define parallelism in this way, I think it will be recognised at once that the second and third forms of the axiom are merely two different ways of saying the same thing.

However, as truth and falsehood in nature can never be dependent on the signification of *words*, I may as well say how the axiom would be worded if we define two straight lines to be parallel when they are equidistant along their whole length. (I vastly prefer this definition, though it is not the usual one.) Taking this as the definition of parallelism, Euclid's axiom may be stated thus :—"Two straight lines lying in the same plane, and not being parallel, (*i.e.*, not equidistant along their whole length,) must ultimately intersect if sufficiently produced in both directions."

In Lobatchewsky's geometry, on the other hand, straight lines in a plane need not intersect though they are *not* equidistant along their whole length. They may approach each other for awhile, reach a minimum mutual distance, and then recede more and more continually. Also in Lobatchewsky's geometry *no* two *straight* lines can be parallel, in the sense of being equidistant along their whole length. If two lines are parallel (*i.e.*, equidistant along their whole length), they cannot both be straight. One, at least, must be a *curved* line, *i.e.*, a longer line than some other which could be drawn through any two of its points.

9. "Nothing is said as to the distance away from this line at which the point is to be placed" (page 103). (This quotation refers to the point outside the first line through which the second line is drawn.) The distance of the point from the line may be as short as possible, and still (if Euclid's 12th axiom is untrue) there will be a finite angle through which the rotating line can be turned without *ever* intersecting the fixed line: the magnitude of this angle depending partly on the distance of the

point and partly on the nature of the space under consideration (*i.e.*, on the degree to which the space deviates from the properties of the ideal space of Euclid). For there are spaces *and* spaces which satisfy Lobatchewsky's conditions. There is only one space which satisfies Euclid's conditions, but there is an infinite number satisfying Lobatchewsky's. They vary through infinite gradations, from one which has such feeble "negative curvature" that it can hardly be distinguished from Euclidian space, to one which has such strong "negative curvature" that even $P\ Q$ (in the annexed figure) would not meet $A\ B$, but would rapidly come to its point of minimum distance ($M\ N$), and would then recede for ever from $A\ B$.



Now, in regard to the space we actually live in, we ought, in my opinion, to say this: "It may be Euclidian, or it may have negative curvature: but if it has negative curvature, that curvature must be excessively weak, though not *infinitely* weak, as is suggested." Professor Clifford puts the case very well in his lecture on "The Aims and Instruments of Scientific Thought." He says: "Suppose that three points are taken in space, distant from one another as far as the sun is from α Centauri, and that the shortest distances between these points are drawn so as to form a triangle, and suppose the angles of this triangle to be very accurately measured and added together: this can at present be done so accurately that the error shall certainly be less than one minute, less therefore than the five-thousandth part of a right angle. Then I do not know that this sum would differ at all from two right angles; *but also I do not know that the difference would be less than ten degrees, or the ninth part of a right angle. And I have reasons for not knowing.*"

Clifford introduces this example by saying, what requires to be much insisted on, that these speculations on non-Euclidian space are not merely questions of words, as many people imagine, but that the issue involved is "a very distinct and simple question of fact." In plain language, geometry is a *physical* and *experimental* science, just as much as optics or physiology; and the properties of space cannot be evolved from man's inner consciousness, but must be determined by *experiment* and *observation.* There was as much justification, before the curvature of the earth was known, for erecting into an axiom the proposition that all verticals are parallel—(For myself, I cannot, even now, *imagine* its falsehood, although I of course *know* it to be false)—as there is now for the statement, *a priori*, that two shortest lines cannot enclose a space, or that the three angles of a triangle are exactly equal to two right angles.

10. " . . . it appears to me that even if the angle of convergence is infinitely small the lines would intersect, but not, of

course, at any determinable or conceivable distance" (p. 103). This is beside the question. The true question is, whether they will necessarily intersect if the angle is, for instance, one decillionth of a degree. Those who regard the Euclidian geometry as absolutely true, must hold that they will. Modern mathematicians, on the other hand, say that we do not know whether they will or not. Who can prove that they will? Euclid frankly admitted that he could not, by *assuming* the alleged fact as his twelfth axiom. Since Euclid's time, scores of mathematicians have tried to prove it, but all their attempted proofs are justly regarded by their fellow-mathematicians as simply inconclusive. It *cannot* be proved. Experiment cannot prove it; reasoning has failed to prove it: our intuitions—if, as disciples of the experiential school of philosophy, we believe they have been produced by the experience of our ancestors through millions of years in the portion of space passed through by our solar system in that time—cannot be trusted as infallible, and, therefore, cannot prove it. Lastly, it will not be contended that any supernatural revelation has been vouchsafed on this point.

11. "None of the evidence of Lobatchewsky in favour of this is given by Mr. Frankland" (p. 104). It did not fall within my province to give this evidence. It is to be found in Lobatchewsky's works. The evidence is admitted, and has long been admitted, to be conclusive by all mathematicians who have studied the question. Also, I think I may fairly add that the burden of proof lies with those who say that an intersection must and will take place, not with those who say that it may or may not take place.

12. "It appears to me that at any finite angle of convergence of $C D$ to $A B$ they will intersect at some determinable part of the line $A B$, *for a finite angle can only mean an angle of such a size* that it can be measured or conceived of." Just so: it can be measured by the ratio of a finite arc (subtended by the angle) to the radius of the same circle. But this does not prove that it must be measured by a portion of the straight line $A B$. How, then, does it follow as a "necessary corollary" that "there is a point along $A B$ which the line P will pass through?" (p. 104.) It will hardly be considered a proof to say that "It seems that the completion of the ideal construction thus begun demands this intersection" (p. 103). If this can be proved, the most remarkable advance in geometry since the time of Euclid himself will have been made. A whole literature has grown up in the attempt to furnish this proof. Its growth has been arrested by the discoveries of Lobatchewsky and Gauss, and I feel very sure that the desired proof will never be forthcoming.

13. Mr. Frankland (p. 106, *note*) "gravely informs us here, that the finishing point or goal for a geodesic line in process

of construction is to be the length of such a line away from the starting point of that line. The two points are to be apart, yet coincide!" Where is the contradiction? In the manifold I describe, as on the surface of a sphere, a geodesic starting from any point leads back eventually to that point. So far, my manifold and the surface of a sphere resemble one another. The difference is this: If two persons on the surface of a sphere (say the earth) were to start from the same place, and travel along geodesic lines, they would cross each other's paths at a half-way house (on the other side of the sphere), and then again at the starting point. But on the manifold I have investigated they would, after travelling a certain distance, get back to the starting point, *but without ever having crossed each other's paths in the meanwhile.* On a Euclidian plane, on the other hand, they would obviously never either cross each other's paths or get back to the starting point at all.

14. "Geodesic lines, then, proceeding from some common point of a surface, are to diverge somehow from the polar of that point" (p. 106). I do not know what Mr. Skey means by the "polar of that point," unless, indeed, it be the *opposite* point. If so, I reply that in my manifold, which for the future we may for convenience call the "finite plane,"* a point has not *one* opposite only (like a point on a sphere), but a whole row of opposite points: that is to say, an opposite *line.* The geodesic lines proceeding from a common point cut this "opposite line" (which I have called the polar) in *separate points, each of which* is equally "opposite" to the common centre of radiation.

15. "He is assuming a uniformly curved surface of immense size" (p. 106). By no means. The manifold may be of any size, large or small. Its total area may be less than the decillionth part of a square inch—yet it will have its complete and thoroughly self-consistent, though, I admit, quite unimaginable, geometry. What I do say is that, if any surface *constructible in the space in which we live* possesses the properties of a "finite plane," then that surface must be of immense size, for we can prove by experiment that no closed surface of *moderate* area constructible in our space does possess these properties.

16. "It is manifest that the analytical conception of two geodesic lines refusing to intersect each other more than once, and so enclosing but one space, is founded upon Lobatchewsky's conception of what parallel straight lines are capable of" (p. 106). This is not so. It is founded on just the opposite conception. Lobatchewsky's conception is that of two geodesic lines which, even though converging at first, do not ultimately intersect; mine is that of two geodesic lines which ultimately intersect,

* The manifold in question possesses the same properties as the "plane at infinity," well known to students of solid geometry.

even though divergent at first. In Lobatchewsky's space the three angles of a triangle are always together less than two right angles: in the "finite plane" (and also in the corresponding space of three dimensions,) they are always greater than two right angles, just as the angles of a spherical triangle are. In Lobatchewsky's space, figures have their edges and corners sharpened when their linear dimensions are proportionately increased: in the "finite plane" they have their angles blunted on being magnified, (like the figures on a sphere,) and in the corresponding space of three dimensions solid figures would also have their edges and corners blunted on being magnified.

17. "It is, I think, abundantly evident that the analytical conception of a surface such as the one which has been worked upon for the discoveries communicated in his (Mr. Frankland's) paper, is not, in reality, valid, and that though possibly not self-contradictory, as he urges, it requires premises which *are* of this nature"—*i.e.* self-contradictory (p. 107). Not so. The premises are not self-contradictory, but only contradictory to some of our strongest and firmest intuitions—viz., our space-intuitions. But so is the convergence of verticals, already alluded to, and yet it is an unquestionable fact. Believing, as I do, that our space-intuitions are derived simply from ancestral experience, aided by natural selection (which must always have tended to eliminate those in whom such intuitions were relatively weak), I can only admit that they are reliable enough *for practical purposes;* not that they are exactly true through all space and time. The parallelism of verticals was an intuition, (a sort of dynamical intuition,) ingrained in our mental constitution by ancestral experience through innumerable generations. Were we blind, and confined (say by surrounding climates of excessive rigour) to a very limited area of the earth's surface, I think it very likely that this conception would to this day seem to us self-evidently true. It would seem as certain that two verticals must have the same direction as it now does that two shortest lines cannot enclose a space. A Skey, in such a world, might even have argued that to construct a system of cosmography in which two verticals should not have the same direction would be, "though possibly not self-contradictory," to assume "premises which are of that nature." In any case, I do not think that any self-contradiction can be shown to be involved in the proposition that two geodesic lines, though finite in length, intersect only once.

18. "Referring to the idea that the universe is of finite extent," . . . . the Professor "argues that 'in this case the universe is again a valid conception . . . . for the extent of space is a finite number of cubic miles'" (p. 107). In this quotation from Professor Clifford, two important words

are omitted. The original reads thus:—"In this case the universe, *as known*, is again a valid conception," &c. Professor Clifford very clearly explains what he means by this, in an earlier part of the lecture from which I quoted. Referring to the state of science before Lobatchewsky he says, " . . . the laws of space and motion that we are presently going to examine, implied an infinite space and an infinite duration, about whose properties as space and time everything was accurately known. The very constitution of those parts of it which are at an infinite distance from us, 'geometry upon the plane at infinity,' is just as well known, if the Euclidian assumptions are true, as the geometry of any portion of this room. In this infinite and thoroughly well-known space the universe is situated during at least some portion of an infinite and thoroughly well-known time. So that here we have real knowledge of something at least that concerns the cosmos; something that is true throughout the immensities and eternities. That something Lobatchewsky and his successors have taken away. The geometer of to-day knows nothing about the nature of actually existing space at an infinite distance: he knows nothing about the properties of this present space in a past or a future eternity. He knows, indeed, that the laws assumed by Euclid are true with an accuracy that no direct experiment can approach, not only in this place where we are, but at places at a distance from us which no astronomer has conceived: but he knows this as of here, and now; beyond his range is a there, and a then, of which he knows nothing at present, but may ultimately come to know more. So, you see, there is a real parallel between the work of Copernicus and his successors on the one hand, and the work of Lobatchewsky and his successors on the other. In both of these the knowledge of immensity and eternity is replaced by knowledge of here and now. And in virtue of these two revolutions the idea of the universe, the macrocosm, the all, as a subject of human knowledge, and therefore of human interest, has fallen to pieces."

Well, then: If space should turn out to be of finite extent, the idea of the universe (the universe of *matter* at any rate) would be reinstated, as in a certain measure an object of knowledge throughout its entire extent, as it was supposed to be before Lobatchewsky arose, when Euclidian geometers could tell us the exact constitution of the whole of space.

19. "To make the conclusion agree with the premises, it should have gone no further than to affirm that the universe may not differ *sensibly* from an infinite one" (p. 108). By no means: The surface of a sheet of still water does not differ sensibly from a Euclidian plane, but the surface of the Pacific Ocean, even if perfectly calm, differs very sensibly from a plane,

The imperceptible divergence of small portions from the ideal standard is *cumulative*, and when we take very large portions the divergence accumulates to a very perceptible amount. The difference between the geometry of a cubic mile, if Euclid's assumptions are true, and the geometry of a cubic mile if they are false, we know, by experiment, to be quite insensible: yet by the accumulation of excessively small (though not infinitely small) divergences, it comes about that the geometry of a decillion cubic miles (*i.e.*, 10^{60} cubic miles) may be so different on the two hypotheses, that while, if Euclid's assumptions are true the decillion cubic miles are but an infinitesimal portion of entire space, if his assumptions are false, all space may actually not hold so large a number of cubic miles.

20. "The Professor, having perchance, after all, some doubts as to the validity of this deduction, or possibly forgetting he has *proved* it, essays to prove it again; he says, 'and this (finiteness of the universe) comes about in a very curious way'" (p. 108). I can assure my critic that Professor Clifford had no such doubts. If the universe is such that two shortest lines may enclose a space, and if, nevertheless, all the other assumptions of Euclid are true, then the extent of space is *certainly* a finite number of cubic miles. The one statement is logically involved in the other, though it may require a long and intricate process of reasoning to prove it so.

21. "The qualification put upon straight lines, '*straight according to Leibnitz*,' put, no doubt, all in good faith, as explanative of straight lines, it does still, I feel assured, confer upon them properties which straight lines have not" (p. 108). It undoubtedly confers upon them properties which Euclidian straight lines have not; but the lines in question, though not Euclidian straight lines—and if you will, not *straight* lines at all, for the quarrel need not be over a word when the issue is one of fact—may nevertheless be the straightest lines that can possibly be constructed (even ideally) in the space in which we actually live. In other words, space may be so constituted that what Euclid calls straight lines cannot possibly be constructed in it, any more than a straight line can be constructed on the surface of a sphere. Nevertheless the straightest lines constructible may be of the same shape all along *and on all sides*, which great circles of a sphere are not: for though of the same shape all along, they are concave on the one side and convex on the other, also they may be shortest lines, which the great circles of a sphere are not, relatively to solid space. The quarrel about the definition of a straight line does not affect the issue in the smallest degree.

22. "I blame making so much, in this way, of the gap 'in the chain of reasoning,' by which the truths of geometry should be logically connected and represented" (p. 109). They *cannot*

all be logically connected. Not one, but several, unproved assumptions must be made before a definite geometry can be constructed. The difficulty does not arise from shortcomings in the definitions, though these are undoubtedly defective. Frame what definitions we please, we must still assume certain *matters of fact*, or *alleged* matters of fact (call them axioms or call them postulates), before we can logically raise the superstructure of the Euclidian geometry. Even if we define straight lines and planes as such lines and surfaces that the propositions of Euclid respecting straight lines and planes shall be true respecting them, even by this extreme procedure we get no nearer the desired goal: for it then remains to be proved that straight lines, planes, parallels, &c., *exist in the space in which we live.* To assume that they do is to assume a whole congeries of axioms. A writer named Thomson once wrote a book called "Geometry without Axioms," which was certainly a desperate effort to get rid of unproved assumptions. The attempted proof of the redoubtable 12th axiom was a perfect labyrinth of intricate propositions; but, like all similar efforts, like any efforts which may be hereafter made to ground geometry on definitions and dispense with axioms, it was but "as the helpless waves that break upon the iron rocks of doom."

The science of the space in which we live is a *physical* and *experimental* science, and, unlike arithmetic, algebra, and all the branches of mathematical analysis (the general theory of manifolds among them), cannot be evolved out of man's inner consciousness.

Art. VIII.—*On a new Form of Seismograph.*

By F. Bull.

[*Read before the Wellington Philosophical Society*, 23*rd September*, 1885.]

The prevalence of earthquakes in New Zealand, and at the same time the uncertainty in the reports from the different parts of the colony, as to their occurrence and direction, owing to the want of proper instruments for their detection, led me to consider the possibility of devising an apparatus which would at once place on record the occurrence of shakes and indicate their direction. Accordingly I set to work, and commenced by planning all sorts of complicated machines, which did not at all satisfy me; and I eventually came to the conclusion that the most simple and direct-acting machine would be the best for the purpose.

The first plan I then adopted was to suspend a heavy sphere of lead, having on its under-side a small tube, fixed vertically, in which a pencil fitted, with freedom to ascend and descend in

the tube like a piston. The point of this pencil rested on the table or base of the apparatus, at the centring point of lines drawn from the four cardinal points. This weight I suspended by a fine brass wire from the centre of a beam, supported on two tall uprights from either side of the wooden table or stand, on the upper surface of which I fixed a paper showing the points of the compass before mentioned. Of course, any motion taking place at the base, such as the movement of an earthquake, would cause a corresponding pencil-mark on the diagram in the direction of the disturbance, it being understood that the suspended weight remained quite motionless ; but I had to discard the scheme as being only partially successful, owing to the fact of the earth's motion being communicated (to a certain degree) to the pendulum as well as to the base : whereas, for accurate results, the pendulum should have been disconnected from, and independent of, the diagram, or part which received the earthquake motion.

My next effort resulted in the Seismograph which I have to bring under your notice this evening, and I am pleased to be able to state that I have had proofs that satisfactory results are obtainable from it. You will observe it consists mainly of an inverted basin, heavily weighted round the edge, and balanced on a steel point, the centre of gravity being maintained by means of a disc of steel fixed in the centre of the basin.

The pointed steel rod is firmly fixed in the centre of the stand, which is a substantial wooden one, and from its four sides rise a like number of slight wooden uprights, representing the four cardinal points, and also intended to receive the delineation of the earthquakes as received from the pointers attached to the basin.

On the inner faces of these uprights is fastened a piece of white paper, and over the paper is a piece of sheet glass, the surface of which is smoked over, and the points of the markers rest against this smoked surface. The markers are made of metal, and are hinged to the rim of the basin, allowing the pointed extremities to rest easily upon the glass. A small piece of lead is attached to the under-side of each marker, so as to render the pressure sufficient to keep the point and the glass surface in constant contact. I should mention here that I only use two of the uprights, and have only two pointers, for the reason that one answers equally for the north and south, and the other for east and west, and the use of four would, no doubt, tend to lessen the susceptibility of the instrument.

Having now described the form of the instrument, I will explain its action, though I think but little need be said on this point, as the apparatus is so simple that no doubt you will already have understood its action. In the normal condition of the machine, the rim of the basin preserves a position parallel

to the plane of the base or stand, the markers resting upon the smoked glass, which presents an unbroken dark surface. Now it follows that any alteration in the position of the base, such as an upheaval, or the reverse, of the extremities, as would be caused by an earthquake, must result in a corresponding mark on one or both of the smoked glasses from their contact with the points of the markers, and thus we have the register of the shake. The marks on the glass are rendered the more noticeable on account of the white backing showing through, where the smoke film has been removed.

When I first constructed the machine, instead of rigid metal markers on hinges I used fine wires, bent so as to form a weak spring; and at the points were soft lead pencils, which were to mark the seismic disturbances on a surface of hard drawing-paper instead of glass. But, although fairly successful, I found that after the machine had been undisturbed for any length of time the points had a tendency to settle themselves in the surface of the paper, and a slight shake was not enough to displace them, but the movement became expended in the suppleness of the springs. Accordingly, I substituted the glass surface for that of paper, and the direct-acting hinged markers instead of the springs, and I think we have now an instrument which has the recommendation of being simple in construction, inexpensive, and reliable.

Of course the instrument before you is capable of improvement, in the way of more skilful workmanship, as it is not possible with only a few tools and a kitchen table to turn out very highly finished work; and a real improvement could be effected by substituting an agate centre for the metal one I have used. However, I have, I think, succeeded in producing an instrument, which if properly set up, free from disturbing influences apart from those which its object is to register, will give satisfactory results, and which, from its inexpensiveness and utility, I venture to suggest, might be supplied by the Meteorological Department to numerous stations throughout this colony, and thus allow of a comprehensive and reliable record being kept of the seismic movements so often occurring. I may state that a large number of instruments for this purpose are in use in other countries, and it is only about two years ago that a considerable sum was granted by the Indian Government for supplying all the Meteorological Stations in Bengal and Northern India with instruments. The form of these instruments I have not the least idea of, but I have no doubt that they are much more elaborate, and certainly more costly, than the one I have shown you this evening.

II.—ZOOLOGY.

Art. IX. — *On an "Index - Collection" for small Zoological Museums, in the Form of a Genealogical Tree of the Animal Kingdom.* By T. Jeffery Parker, B.Sc., Professor of Biology in the University of Otago, and Curator of the University Museum.

[*Read before the Otago Institute, 9th June,* 1885.]

The main thing which distinguishes a museum from a collection of curiosities is arrangement. The object of the unscientific collector is to make his cabinet of "curios" look as attractive as possible, and to this end he does not hesitate to mix together stuffed birds, coins, savage implements, eggs, and minerals, for the sake of securing an effective arrangement of form and colour. In a scientific museum, on the other hand, the object aimed at is to place like things with like; to have the minerals, shells, birds, etc., etc., each by themselves, and the individual members of each group arranged according to some definite standard of classification. In this way, the visitor is, as it were, compelled to see the objects exhibited in a definite order, and is thus led to compare not only object with object, but also group with group.

It is, however, obviously difficult to do this thoroughly. In any ordinary museum building it is practically impossible so to arrange the doors, passages, galleries, etc., that the visitor is obliged to traverse them in a certain direction, and so to have forced upon him the natural sequence and grouping of the objects he sees. Moreover, the fact that certain forms of glass cases are suitable to one class of objects, and not to another, often prevents a strictly natural arrangement. For instance, in the Otago University Museum, the necessity for exhibiting both birds and mammals in large wall-cases, has necessitated the former group being placed in the upper gallery, the latter on the ground floor, the lower vertebrates occupying an intermediate position in the lower gallery. Similarly, most invertebrates are, from their small size, best exhibited in flat or "desk" cases, which could only be conveniently placed round the two galleries and between the windows in the lower gallery, in places where wall-cases were inadmissible.

A brief account of the general arrangement of the zoological collection will show clearly enough that, in spite of the plan recently adopted of placing over or in each case labels giving names of the groups represented in it, the natural sequence of the groups is by no means obvious to an ordinary observer.

The general collection of invertebrata extends round three sides of both galleries: from protozoa to brachiopoda in the upper; mollusca and tunicata in the lower gallery. The New Zealand invertebrates are placed in a single row of desk-cases, extending along the west wall of the lower gallery. The fishes, amphibia, and reptiles occupy the wall-cases in the lower gallery; a few of the smaller specimens (fossils, &c.) of the same groups are placed in desk-cases, and a considerable number of spirit specimens on a shelf, extending round three sides of the gallery, above the cases containing the mollusca. Lastly, as mentioned above, the birds occupy the wall-cases of the upper gallery, and the mammals those of the ground floor. Some of the larger specimens of the latter group are placed, not in cases, but in railed-off enclosures, in the centre of the ground floor; and the skeletons of moas and other large struthious birds are, on account of their great size, similarly disposed. In the case of vertebrata, as in that of invertebrata, the New Zealand specimens are kept separate from the general collection.

It is obvious that what is wanted, if the Museum is to be in any way an educational institution, is some contrivance for showing the relations of the various groups of animals to one another, and the place in the Museum where the representatives of each group are to be found. If this is done, the intelligent visitor, who, without time or inclination for exact scientific study, yet wishes to get some notions of natural history, will be guided in his search; and with the aid of a good popular work, such as Miss Buckley's "Life and Her Children," and "Winners in Life's Race," or Cassell's "Natural History," be enabled to acquire a fairly clear and accurate, although naturally superficial, knowledge of the form and general structure of animals, and of their relation to one another.

In the new Natural History Museum at South Kensington, this is done by setting apart the great central hall for an "Index-Collection," in which are exhibited types of the various groups of minerals, plants, and animals. But as the whole of our local museum would go into the hall in question, it is plain that we must be content with something on a very much smaller scale.

To confine ourselves to the zoological collections, which take up by far the greater part of the Museum, it would seem that what we want is a collection in which each of the main groups of animals is represented by one or more examples, and in which these are arranged in such a way as to bring forcibly before the observer the mutual relations of the groups which they typify.

Since the theory of Organic Evolution has been recognized as the central doctrine of Biology, all classification of living things has been founded on the idea of genetic relationship.

From this it seems to follow that the best way to arrange a small index-collection of the kind mentioned in the preceding paragraph, is in the form of a solid phylogenetic diagram or "genealogical tree."*

The model now exhibited is an attempt to carry out the principles just laid down. In it the main line of descent from protozoa to the higher vertebrata is represented by a vertical rod of wood three feet high, about $1\frac{1}{2}$ inches in diameter at its lower end, tapering somewhat towards its upper end, and firmly fixed below into a flat stand about one foot square. The various groups which do not lie on this main line are represented by side branches, which have usually an upward direction, but are inclined downwards from their point of origin in the case of degenerate types. Actual specimens, or, when these are unattainable, models of one or more examples of each group are placed in appropriate positions on the stem and branches, and labels are attached, giving (*a*) the name of the group, (*b*) the name of the representative specimen or specimens, and (*c*) the place in the Museum where the collection of specimens of the group is to be found.

I need hardly say that in the present condition of our knowledge of zoology, the subjective element enters very largely into the construction of a model such as this, and that the progress of research is certain to make alterations in detail necessary. I hope, however, that I have succeeded in representing with some degree of accuracy the mutual relations of the various animal groups.

Near the bottom of the stem is placed a model of an Amœba (*A. radiosa*), representing the myxopodous or pseudopod-bearing section of the protozoa, and a little higher up a model of one of the collared monads, (*Monosiga gracilis*) representing the mastigopodous or cilium-bearing section of the same group. Close to the monad arises an ascending side-branch, bearing on its extremity a specimen of one of the New Zealand fibrous sponges (*Chalinula sp.*) as an example of the Porifera.

A short distance above the Amœba and the monad, on the main stem, the group of Cœlenterata is supposed to begin, and is represented by models of a jelly-fish (*Chrysaora cyclonota*), and of a sea-anemone (*Stomphia churchiæ*), the former being suspended by a wire, the latter placed on a small bracket. From this part of the stem a branch arises, representing the echinoderm phylum, and bearing a specimen of a star-fish (*Asterias forbesii*).

Still higher up the main stem the Type or Sub-kingdom *Vermes*

*My friend Professor Haddon, of the Royal College of Science, Dublin, has devised a most ingenious form of "diagram in three dimensions," excellent for lecture purposes, but less suitable in many ways for permanent exhibition in a museum than the one I propose.

begins; the lower or flat-worms being represented by a model of a planarian (*Stylochus sp.*), the higher or articulated worms by a specimen of a New Zealand *Nereis*, prepared by Semper's dry method. The *Nereis* is placed as if crawling on to a long side-branch representing the arthropod phylum, and bearing specimens of the New Zealand fresh-water cray-fish (*Paranephrops setosus*), and the red-admiral butterfly (*Pyrameis gonerilla*).

Somewhat below the origin of the arthropod branch, and from the opposite side of the stem, springs a branch representing the group of Mollusca, and bearing an oyster (*Ostræa edulis*), and a model of the cellar-slug (*Limax flavus*). Close to the origin of this, two short and slender branches arise from the main stem, one bearing a brachiopod (*Terebratella vitrina*), the other a polyzoon (*Retepora cellulosa*).

A few inches above the worms, the vertebrate (or chordate) phylum is supposed to commence. Two descending branches, arising near together, represent the degenerate groups of the Tunicata (*Urochorda*) and Acrania (*Cephalochorda*): on the Tunicata branch is placed a model of a simple ascidian (*Microcosmia pyriformis*); from the end of the neighbouring branch is suspended a model of the lancelet (*Amphioxus*).

A short distance higher up the stem is another descending branch, on which is fixed a stuffed specimen of one of the New Zealand fresh-water lampreys (*Geotria chilensis*), representing the probably degenerate group *Cyclostomata*. Above this begins the lowest group of gnathostomatous vertebrata, the class *Pisces*, represented by a small specimen of the common New Zealand dog-fish or smooth hound (*Mustelus antarcticus*) suspended from the main stem. Still higher, also suspended from the main stem, is a specimen of the axolotl (*Amblystoma tigrinum*) as an example of the Amphibia.

A little above the place of attachment of the axolotl, the vertical stem comes to an end as such, dividing into two opposite branches of unequal length, the shorter representing the Sauropsida, the longer the Mammalia. On the proximal end of the shorter branch, representing the Reptilia, a specimen of the New Zealand spotted lizard (*Mocoa grandis*) is placed, close to the fork, and with its tail winding round the upper end of the main stem. On the distal extremity of the shorter branch is perched a New Zealand parrakeet (*Platycercus novæ-zealandiæ*) as a representative of Birds, while in a corresponding position on the longer branch is a marmoset (*Hapale jacchus*) as an example of Mammalia.

The labelling is an important feature of the model. For each group—type, or class, as the case may be—a label is provided giving the scientific and English names of the group, and of the species chosen to illustrate it, and indicating the place in the Museum where further examples of the group are to be

found. Two examples will illustrate the method of labelling adopted :—

Type ARTHROPODA,
Including Crayfishes, Crabs, Centipedes, Spiders, Insects, &c.

Examples :

1. The Fresh-water Crayfish (*Paranephrops setosus*).
2. The Red Admiral Butterfly (*Pyrameis gonerilla*).

General Collection.—Upper Gallery, N. and S. sides, Desk Cases 18—38; Spirit Specimens on shelf above cases.
N.Z. Collection.—Lower Gallery, W. side, Desk Cases 5—11; Spirit Specimens on shelf above cases.

Class AVES (Birds).

Example :

Red-fronted Parrakeet (*Platycercus novæ-zealandiæ*).

General Collection.—Upper Gallery, Wall Cases on E., W., and S. sides; Skeletons of Ostrich, &c., on ground floor, South enclosure.
N.Z. Collection.—Upper Gallery, Wall Case on N. side.
Moa Remains.—Ground Floor, S. enclosure; Upper Gallery, Desk Cases 41—43, and small wall case at S. end.

I am aware that several objections may be made to the construction of this model. From the strictly scientific point of view, undue prominence is given to the vertebrata, while many interesting invertebrate groups are omitted altogether. But this is done purposely: the vertebrata must of necessity occupy a far larger share of museum space, and attract more attention, than invertebrates; so that it is, I think, advisable to call special attention to the classes of vertebrates, while the invertebrata may well be considered by sub-kingdoms or types. Again, the retention of the type *Vermes* is a sacrifice of strict accuracy to convenience; but the curator of a small colonial museum may be pardoned for sinning, in this matter, in company with Professor Claus, in whose text-book (English Edition, vol. i., p. 303) the same conventional union of the various and divergent worm-classes is made.

It is also incorrect to place any existing species, or indeed any existing lesser group, on the direct line of descent of the higher animals. For instance, it is tolerably certain that none of the ancestors of existing birds and mammals would, if discovered, be classifiable with any of the existing subdivisions, either of fishes or of amphibia; but it is none the less certain that what may fairly be called piscine and amphibian stages must have been passed through.

As a final objection, it may be said that a more correct mode of construction for a model of this kind would be to make the branches of such a length as to bring the ends of all of them, and consequently the specimens they support, to one level: advance of organization would then be indicated, not by height above the ground, but by distance from a centre, and all but the

distal ends of the branches would represent extinct forms. But such a model would be far less convenient than the one I have adopted.

In spite of these and other obvious objections in detail, I think the model may be considered as showing, fairly accurately, the main facts of zoological classification. For instance, it illustrates the impossibility of making a linear classification of animals: it shows the futility of discussing whether molluscs are "higher" or "lower" than arthropods, both being shown to have arisen from comparatively low worm ancestors, and to have reached a high level of organization along totally different lines: it shows how, by degeneration, Amphioxus, although a vertebrate, has sunk below the level of organization of many invertebrates, and is as much below an ordinary fish as a fish is below a man: it further illustrates the now established fact, that while the two lowest groups of gnathostomatous vertebrates — fishes, and amphibia — lie, speaking generally, in a linear series, the higher groups diverge in two opposite directions, birds springing undoubtedly from reptiles, mammals either from archaic reptiles or from some unknown group intermediate between reptiles and amphibia.

One advantage of the model I must not fail to mention: its construction is simple enough to allow of comparatively easy alteration in the place of origin or direction of the branches, whenever the progress of zoology necessitates a change in our view of the relations of any group.

Art. X.—*Notes on a Skeleton of* Notornis, *recently acquired by the Otago University Museum.*

By T. Jeffery Parker, B.Sc., C.M.Z.S.

[*Read before the Otago Institute, 11th August, 1885.*]

Some months since I was informed by Mr. Edward Melland that the skeleton of a Takahe had been found on his station, near Lake Te Anau, by Mr. Richard Henry, who, having a strong taste for natural history, had recognised the bones and carefully collected them.

The specimens were forwarded to Dunedin, and Mr. Melland was good enough to bring them to the Museum for my inspection. As the more important bones were present, and in very good preservation, I was glad to be able to purchase them, and thus to make a very important addition to the collection of native birds.

As is well known, the only recent remains of *Notornis* hitherto obtained are the two stuffed specimens in the British

Museum, procured by Mr. W. Mantell in 1849, and the skin and skeleton of a bird caught alive near Lake Te Anau in 1879. I had the honour of exhibiting the two latter at a meeting of this Institute on 6th April, 1881, and, at a subsequent meeting, of reading a paper on the skeleton.* Both skin and skeleton were sent to England for sale, and were purchased by the authorities of the Dresden Museum for £110.

Besides the above-mentioned specimens, the only remains of *Notornis* of which I am aware are the fossil bones in the British Museum, upon which the genus was founded by Owen.†

The Te Anau specimen of 1879 naturally attracted a good deal of attention in Europe. It was exhibited by Professor Newton at a meeting of the Zoological Society, on 17th January, 1882,‡ and subsequently furnished the subject of a paper by the first describer of the genus, Professor (now Sir Richard) Owen.|| After its purchase for the Dresden Museum, the skeleton was briefly described by the Director, Dr. A. B. Meyer, his account being accompanied by a series of measurements, and by four beautifully executed autotypes.§ The latter, I have had framed for exhibition in this Museum, and am thus enabled to exhibit them to-night for comparison with the actual skeleton.

The bones which form the subject of the present communication were found, (as stated by Mr. Henry in a letter to Mr. Melland,) in a small patch of scrub, about half a mile to the east of Patience Bay—the southernmost arm of Lake Te Anau. The surrounding district consists of low-lying fern and tussock country, and the patch of scrub in which the bones were found contains a few mapau (*Pittosporum tenuifolium*) and "lawyer" (*Rubus australis*) bushes; some miko-miko (*Aristotelia racemosa*) and manuka (*Leptospermum scoparium* and *L. ericoides*), and an acre or two of rushes (*Juncus*, various species). Within a hundred yards of the scrub a small creek arises, and discharges into the lake. The pelvis, vertebræ, etc., all lay on an area not larger than a sheet of writing paper, but one of the leg bones was found thirty feet away, quite outside the scrub, and other bones six feet from the main heap. One would imagine that rats caused this dispersal of the bones, and the consequent incompleteness of the skeleton.

Mr. Henry also states that the skeleton of 1879 was found at the edge of a patch of bush, about 200 acres in extent (locally known as the "Wilderness"), situated immediately to the north

* "Trans. N.Z. Inst.," vol. xiv. (1881), pp. 245, 561, and 562.

† "Extinct Birds of N.Z.", pp. 173, 196, 199, and 436; and "Trans. Zool. Soc.," iii., p. 366; iv., p. 12; viii., p. 119; and vii., pp. 369 and 373.

‡ "Proceedings Zool. Soc.," 1882, p. 97.

|| Ibid., p. 689.

§ Abbildungen von Vogel-Skeletten, iv. and v. Lieferung. Dresden, 1883.

of the Mararoa river, about 3½ miles east of Whitestone river, a tributary of the Mararoa, and 9 miles south-east of the extreme south end of Lake Te Anau. The name, "Bare-patch," applied by Dr. Buller to the locality,* does not seem to be in general use, since it is unknown both to Mr. Melland and to Mr. Henry, both of whom have known the district for several years.

The Dresden and Dunedin specimens of *Notornis* were there found, not more than 8 or 9 miles apart.

The skeleton, as it reached the Museum, consisted of the following bones:—

The skull and lower jaw.
The sternum.
The left coracoid and both scapulæ.
Both humeri.
The right ulna.
The coalesced 2nd and 3rd metacarpals of the left side.
The pelvis.
Both femora.
Both tibiæ.
Both fibulæ (one broken).
Both tarso-metatarsi.
One of the proximal phalanges, probably that of the 3rd left toe.
Six cervical vertebræ.
Seven thoracic vertebræ.
Five ribs, more or less broken.

The skull is the most interesting part of the skeleton, since in the North Island fossil the brain-case and beak were separate, and both of them more or less broken, while in the Dunedin specimen the occiput was completely destroyed to allow of the removal of the brain. In the present specimen both quadrates and pterygoids are missing, and the left jugal arch is broken, but in other respects the skull is perfect.

The mandible is also quite perfect, and the sternum and pelvis nearly so. The right fibula is broken, only the proximal half being left, but the other limb bones are quite uninjured, as also are the scapulæ, the coracoid, and the vertebræ.

From an examination of the Dresden specimen, Meyer has concluded that the *Notornis* of the South Island, represented by the stuffed specimens in the British Museum and by the Dresden skin and skeleton, is specifically distinct from the North Island form, represented by the original fossil bones. As it was upon these latter that the species *N. mantelli* was founded, Meyer proposes to form a new species, *N. hochstetteri*, for the Southern form. The differences relied upon are in the proportions of the leg bones, which are as follows:—

	N. hochstetteri.	*N. mantelli.*
Femur	10·9 cm.	12·2 cm.
Tibia	16·5 „	20·0 „
Tarso-metatarsus	10·0 „	12·9 „

Judging from the minute differences of plumage, etc., which are considered to be of specific importance by ornithologists, one is disposed to concur in the formation of the new species,

* "Manual of the Birds of N.Z.," p. 65.

however much one may regret the restriction of a well-established and widely-known name.

From the point of view of zoo-geography, it is decidedly interesting to find *Notornis*, like *Orthonyx*, *Petrœca*, *Turnagra*, *Glaucopis*, *Ocydromus*, and *Apteryx*, represented in the two Islands by distinct species.

On comparing the bones of the present specimen with the published figures of Owen and of Meyer, the only matters I consider to be worth mentioning are one or two points of difference in the skull.

In both the Dresden and Dunedin specimens the beak presents a somewhat stronger downward curvature than in Owen's specimen, and the nasal aperture is slightly smaller. A more obvious, although still comparatively unimportant, difference is seen in the relations of the well-marked ridges which bound the temporal fossæ above and behind. The distance between these ridges, or in other words the width of the flattened roof of the skull in the parietal region, is very markedly less in the Dresden and Dunedin specimens than in the North Island fossil figured by Owen, the proportion being about 2 : 3. In the latter, also, the ridge in question forms a very even curve, whereas in both the Te Anau skulls there is a distinct angulation at the junction of the supra-occipital and the parietal. This may be expressed differently, by saying that the temporal muscles are larger in *N. hochstetteri* than in *N. mantelli:* whether the difference is one of age or of sex it is of course impossible to say, but all three skulls appear to be fully adult. The distance between the temporal ridges, at the narrowest point, is 21·75 mm. in Owen's figure, 13·5 both in Meyer's figure and in the present specimen.

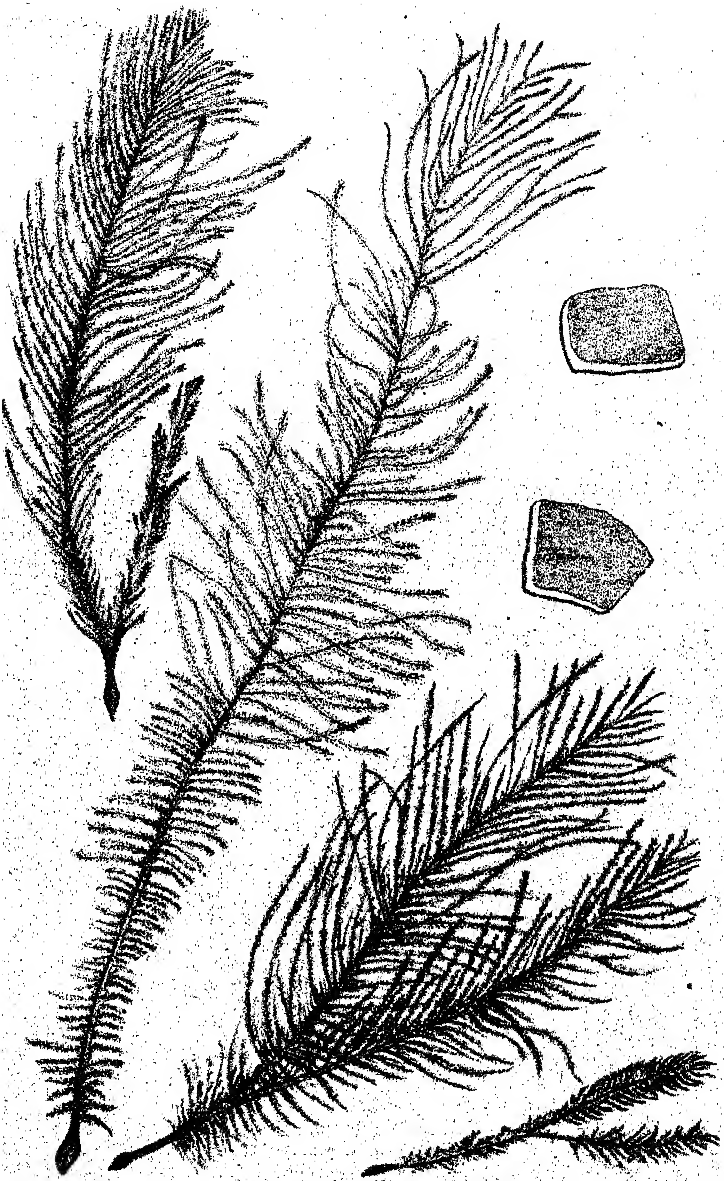
Whether an ornithologist would consider a difference of this nature of any importance I cannot say: as far as it goes, it tends to support Meyer's view of the distinctness of the Northern from the Southern *Notornis*.

In conclusion, I give a series of comparative measurements of the Dresden and Dunedin specimens. I may mention that certain discrepancies between the measurements of the Dresden skeleton, as given by Meyer and by myself in the paper referred to above, are due to the fact that Dr. Meyer has—no doubt, correctly—given in every case the greatest length of the bone, whereas I have given the length of a median longitudinal axis. This makes a great difference, especially in such bones as the sternum. In the following table the measurements are taken so as to compare exactly with Meyer's:—

Skull.—	Dunedin Specimen.	Dresden Specimen.
Length from posterior surface of occipital condyle to end of beak	98 mm.	..
Greatest breadth	45 ..	45 mm.

	Dunedin Specimen.	Dresden Specimen.
Humerus.—		
Length	90 ..	87·5
Breadth of head	21 ..	23·5
,, ,, condyles	15·5 ..	18
Circumference of shaft	19·25 ..	16
Ulna.—		
Length	75 ..	75·5
Breadth of proximal end	14 ..	13·8
,, ,, distal end	9 ..	8·7
Metacarpals.—		
Length	46·5 ..	46
Femur.—		
Length	109 ..	109
Breadth of proximal end along axis of neck	25 ..	27
Breadth of distal end	22·5 ..	27
Circumference of middle of shaft	34 ..	34
Tibia.—		
Length	165 ..	165
Breadth of proximal end	32 ..	31
,, ,, distal end	18·5 ..	22
Circumference of shaft	29·5 ..	29
Fibula.—		
Length	108 ..	112·5
Breadth of proximal end	11·5 ..	12·2
Tarso-metatarsus.—		
Length	98 ..	100
Breadth of proximal end (transverse) ..	19·5 ..	22
,, ,, ,, ,, (antero-posterior)	21·5 ..	24·3
,, ,, distal end	21 ..	23
,, ,, shaft	10·2 ..	10
Sternum.—		
Greatest length	74 ..	75·5
Length of median longitudinal axis ..	62* ..	66
Height of keel	9 ..	8
Coracoid.—		
Greatest length	47 ..	43·5
Scapula.—		
Length in a straight line	74 ..	74·5
,, along the curve	80 ..	80
Breadth of middle	5 ..	5
Pelvis.—		
Greatest length	116 ..	130
,, width	54 ..	55
Width of sacrum	23·5 ..	23

* The middle ziphoid process is broken in this specimen.



M.E.W. del.

To illustrate Paper by T. White.

Art. XI.—*Remarks on the Feathers of two Species of Moa.*

By Taylor White.

[*Read before the Hawke's Bay Philosophical Institute, 14th December,* 1885.]

Plates II. and III.

The accompanying plate (No. II.) contains copies of three Moa feathers, and pieces of egg-shell, found with others in a cave on the shores of Lake Wakatipu, Otago, and mentioned in vol. viii. of "Trans. N.Z. Inst.," p. 98.

The feathers are drawn to scale. The larger one is pure white, and was the only white feather amongst those found, and also the longest.

The feather to the right is in colour like the majority of those found, some of which were an inch longer, others longer and slighter; others again much smaller, and nearly all double-shafted.

In colour, the shaft and centre has a bright transparent yellow, as of gum or resin, changing to dark purple brown on the outer margin of feather. They have probably all been duplicated, the duplicate feather being joined to the principal in what I may call a quill socket, which corresponds with the depth to which the feather entered the skin of the bird; the duplicate feather being slightly shorter, and one-third less in width than the principal.

The left-hand feather represents a third type, which were not so numerous, and all of medium length; they were mostly wanting or denuded of the duplicate shaft. In colour, a dark reddish or chestnut purple; the shafts, more opaque than the above-mentioned, were of a lighter and redder colour than the outer and tip.

These were most likely breast feathers.

The colour of the bird must have been of a most delicate mixture, a foundation of shining yellow outwardly, shaded with dark purple brown, the breast a chestnut purple; and, to locate the white feather, say white on the after part of the back, which cannot rightly be called the tail, as the rump would be covered with drooping hair-like feathers.

The bird would, from the slender make of the feathers, have the appearance of being covered with long flexible hair, and not with immovable armour, showing only the outer colour of the feather as in ordinary birds. From this flexibility, I infer that the golden colour of the centre part of the feather would be visible in the plumage. It was probably about 3 feet 6 inches in height; and, from a metatarsus found in the same cave, is considered to have been *D. casuarinus*.

Several pieces of egg-shell of a light green colour were also found, in what appeared to have been a nest, and are shown on plate II.

The colour of egg-shell is green. This specimen was obtained from sand-drift on the Kawarau River, Otago, and inclines to the presumption that the colour has been bleached out in most of the fragments of egg-shell which are found, any other specimens which I have collected showing no sign of colour. Yet amongst these white shells there is a marked difference in the form of the pit marks or pores of the shell, showing they are different varieties.

Plate III. contains copies of feathers collected from a small cave near Queenstown, Otago, which are mentioned in vol. viii., page 99, "Trans. N.Z. Institute."

These feathers show a considerable quantity of light-coloured down. The longest was a little short of six inches.

They are of at least three classes: First, the longer are narrow and mostly duplicate, a thick light-coloured down extending two-thirds along the shaft; a dark purple brown at tip, the colour lighter at base and along shaft. The second are shorter, wider, and more robust; two-thirds, a thick down, colour darker. A third class, two to four inches long, are probably neck feathers, and are of a more translucent and hairy texture, showing no down and few barbs, the shorter inclining in colour to yellowish brown, others to nearly black.

From the style of these last, the upper part of the neck and the head of this bird were most likely without feathers.

The green egg-shell shown in this plate was found in drift sand on the Kawarau River.

Art. XII.—*Notes on New Zealand Ornithology*: *Observations on* Pogonornis cincta *(Dubus)*; *Stitch-Bird* (Tiora).

By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 1st June, 1885.*]

The first specimens of these birds I saw in the Canterbury Museum (two males, set up). On inquiring, Dr. von Haast informed me they were very rare. The next brought under my notice was a male specimen, in the Auckland Museum; and Mr. Cheeseman told me Professor Hutton, C.M.Z.S., mentioned them as not uncommon on the Little Barrier or Hauturu Island, in the Hauraki Gulf, for which place I started in October, 1880, accompanied by my friend Mr. E. Firth, for the purpose of

M.E.W. del.

To illustrate Paper by T. White.

ornithological researches, and especially with the object of studying the habits of these birds, which I may here mention I have never seen or heard on the mainland or other surrounding islands.

After searching the western and south-western parts of the island, I was unsuccessful in seeing or obtaining a single specimen. I intended penetrating in to the centre, but was informed by the Natives that it was impossible to get overland to the east coast on account of the many precipices, and that the sea was too rough to permit of my landing on that side; so I returned to Auckland, with the intention of resuming the search at another time.

In May, 1882, Mr. Dobson, a friend who has accompanied me in several of my journeyings, preceded me to the same island, for the purpose of repairing old huts and building new ones, taking provisions for a prolonged mountain expedition, my intention being to follow him in June; but, owing to boisterous weather, after making two attempts to land, and having to give it up, once in the *Water Lily* after five days' cruising, and once in the *Rangatira* after three days', I put off my trip till October, on the 15th of which month I succeeded in landing. The first night we camped at the foot of a precipice, the ascent of which we commenced at three o'clock next morning. To give an idea of the difficulty of climbing here, I had to pull my dog (a good Alpine traveller,) up with a rope, in addition to our provisions, &c. After this we climbed over two ranges, each above 2,000 feet high, arriving at an old nikau whare, which my friend had previously built, at the foot of the last range. It was dark before we finished mending the roof and preparing for a start the next day. On the morning of the 23rd, I first heard the whistle of the Stitch-bird: I was unable, however, to get a glimpse of it; and though we cut tracks to the tops of most of the main ranges, and afterwards frequently heard the birds, could never see them. Later experience has taught me that their shrill whistle is very deceptive, and the sound travels a long distance.

I then shifted my quarters further towards the interior; and on the 25th, my attention was arrested by the call of my dog at a short distance. On going towards him I saw a male Stitch-bird hopping about in a very excited manner in the scrub above him. I was so interested in watching this beautiful bird (which has a brighter plumage than any of its New Zealand compeers), with its quick and graceful movements, that it disappeared before I attempted to use my gun.

Though constantly exploring, I never saw another specimen till the 7th November, yet frequently heard them. Early on that morning we travelled north-west to the top of a high, narrow range of precipices, overgrown with short thick scrub

and manga-manga, which made it so dense that I had to cut the way with my hunting-knife. This place I found a favourite resort of these birds, (which have cost me so much time, labour, and patience,) having a warm aspect, exposed to the sun. There I saw male and female, the latter for the first time; but, unfortunately, my friend was carrying the gun, and before he could hand it to me, both birds had disappeared. On the 8th November, I saw a male at the same place, and on going over a range I heard another; subsequently I went round it, and saw male and female near a nest, and endeavoured to observe them unnoticed, but they quickly saw me, and in the act of escaping I shot them. I then went and examined the nest, which was only half finished, built of very small branches, roots, and fine native grass, and lined with hairy substance off the fronds of the *punga*.

In December, 1883, in the centre of the island, I observed a pair of adults with three young birds. On the male noticing me, he uttered a shrill whistle, and the female immediately hid amongst the fern for a considerable time. I procured several specimens; of which I gave Dr. Buller a male, female, and young. I have only once seen these birds sitting still, and that was near the nest. They appear always on the move, carrying their heads proudly, their wings drooped, and their tails spread and raised; and, at each successive movement, they utter that peculiar whistle from which the Natives have named them "*Tiora.*" The female has a different note, sounding like "*tac, tac, tac,*" repeated several times. They feed on small berries and insects, and suck the honey from the native wild-flowers and trees, as many of the latter exude honey during the night. In fine weather I have found them on the mountains between precipices, in low scrub, where the aspect is warm; but in bad weather, lower down in the gullies, in places entangled with numerous creepers. They are not strong on the wing, but very active in hopping and climbing, which enables them to quickly escape from sight.

The plumage of the male is as follows:—Head and neck, shining velvet black, with a few long silvery white ear-feathers; shoulders, golden yellow; upper secondary, white, with brownish black points, and a slight splash of white under the wing covers; wings and tail, brownish black, each feather edged on the outer side with olive green; tail cover, greenish tinge, and a yellow band round the breast; abdomen, greyish brown; bill, black; eyes, dark brown; feet, light brown. The female is a little smaller than the male, of olive brown colour on the top of the head, back, wing, and tail, each feather being shaded with olive green; shoulders, yellowish; upper secondary, white, with yellowish brown shade, ear feathers hardly perceptible, under part brownish grey; bill, legs, and eyes same

as male. So far as I know, the plumage of the young, which differs from that of the adult bird, has never been described :—

Measurement.

Male ..	.. L. 7·50	.. W. 4·25	.. B. ·69	.. T. 1
Female	.. L. 6·75	.. W. 3·75	.. B. ·69	.. T. 1

I landed on my last expedition on the 8th April, 1885, returning in May, during which time I went to the centre of the island, where I knew their favourite resort, to obtain some specimens for the use of the New Zealand museums. I was then successful in observing a pair feed their young, (two males and one female,) which must have been a late brood. I also shot some, shedding their first plumage, as per specimen shown, the yellowish band round the chest beginning to show, also the white ear feathers, and the throat, neck, and head changing from grey to black. When very young, the male is of similar plumage to the female, except the yellow shoulders.

These very rare birds will soon disappear, even from these lonely wilds, owing to the domestic wild cats, which are very numerous, and commit great havoc among them, and also the Sparrow-hawk (*Hieracidea novæ-zealandiæ*) and "Morepork," (*Athene novæ-zealandiæ*) in whose crops I have often found their remains.

Art. XIII.—*Notes on New Zealand Ornithology: Observations on* Procellaria parkinsoni (*Grey*), *Brown Petrel* (Taiko).

By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 27th July*, 1885.]

These birds are found round the coast of New Zealand; I have seen them over a hundred miles from land, cruising about in a similar manner to, and in company with, the Albatross (*Diomedea exulans*), but they never go near enough to a vessel to be caught, nor do they pick up the food thrown overboard, as the Albatross does. This Petrel is gregarious, and I have seen them in large flocks together, resting on the water. Their power of flight is marvellous. In July, 1879, outside the Kaipara, on the west coast of North New Zealand, I had an opportunity of observing these birds, having to lay by outside the bar for several days, being unable to enter, as it was blowing one of the severest gales experienced in these seas; they cruised about, dipping the points of their wings at intervals in the water, then suddenly swooping down through the foaming waves for their prey; rising with the next wave, and repeating their former action. From July to November these birds are always out at sea. In November they come ashore to their breeding places, on the top of high and

steep mountains, which they choose for the purpose of easier flight, as they have difficulty in ascending from the level ground.

They are expert climbers; I saw them, by the aid of their sharp claws, their bill, and wings, climbing up trees out of the perpendicular, from whence they flew away. In November, 1882, on the eastern slope, and near the centre of the Little Barrier or Hauturu Island, situated north of Auckland, at about 2,300 feet above sea level, on a steep precipitous ridge, I noticed my dog repeatedly setting at burrows, which, on examination, I found contained *Procellaria parkinsoni;* they were cleaning out their old burrows; and, staying to observe, I noticed them digging with their bills, removing the earth by a backward motion of their feet, till the burrow was cleansed. In most cases I found them working, in others the burrows were clean and the refuse outside; some burrows in loose soil, others under the roots of trees and under stones, also in hollow trees. I have found them sometimes very far inland, always on the tops of mountains.

In December, 1884, on the Waitakerei Ranges, 1,000 feet above sea-level, and twelve miles from the ocean, I found the female sitting on an egg, nearly hatched. I measured several burrows of these birds, the entrance was from 8 to 12 inches in diameter, the depth from 1½ to 2½ feet, and the height about 1 foot. When they have finished cleaning out the burrows, which process male and female accomplish together, they remain quietly till the last rays of the sun have disappeared, then any one can hear them call, which is similar to the Black Swan (*Cygnus atrata*), and, on coming out, they stop a moment, pick up a few leaves or grass, and go back into the burrows; this they repeat several times, and always on entering the chamber they make a peculiar noise together. After dark both come out, rise and circle round, calling until they attract others, and when a large flock is assembled they fly away to their haunts on the ocean, returning before daylight. At this season, before they lay, they are very fat. When caught, on their return from the ocean, if they cannot protect themselves by scratching and biting, they expectorate a lot of oily matter on their assailant. The first time I caught one of these birds it treated me in this manner. As soon as they have finished building their careless nest, which is a deepening in the chamber, with a few leaves in it, the female lays one white egg about the size of that produced by a Brahma fowl. When the female lays, the male separates from her during the day, while she is hatching, and remains in a separate burrow of his own not far away. The first egg of the *Procellaria parkinsoni* I found on the 28th November, 1882, at the Little Barrier. After this date I found and examined several, but never found more than one egg or young in a nest, and the female always sitting on the egg.

I watched these birds by moonlight, and have seen the male come out of his burrow and fly away; returning after a time, and circling round in the air, he swooped down to the burrow of the female, striking the ground with a force that could be heard some distance. He stopped outside a little, then entered, and I heard a whimpering noise. After this a bird came out and flew away, returning after a time to the same burrow, and in a few minutes once again emerged and flew away; but returned before daylight, and using the same precaution on entering as before. Then one bird came out and went to the second burrow. I examined the burrow where this process was going on, and on putting my hand in it was severely bitten, which was repeated on my trying to lay hold of the bird, which drew back into the chamber. So I dug with a tomahawk till I reached where the bird was sitting, and tried to take the egg from under it, which I partially succeeded in doing, when I was again so severely bitten that I had to let it go. As soon as I did so, the bird with its bill rolled it back into the nest. I protected my hand, and then took the egg, which was quite fresh. My dog went to the bird, which attacked him furiously. On examination I found this was a female. I then went to the other burrow, where I saw the bird go in. This bird defended itself in the same plucky manner. There was no egg in this chamber, and on examination I found this bird was a male. About the end of December I found a female in a burrow, with one small chick covered with grey down, which she defended furiously. I have also found very young birds in January, even as late as April. As soon as the young birds are a few days old, the parents leave them in the burrow from before sunrise till after sunset, while they go to seek food. On their return, they circle round the burrow as before, stopping at the entrance to call, which the young birds immediately answer. After entering they make a whimpering noise. The old birds leave and return several times in a night. Once or twice only have I found adult birds in the burrow during the day, when they had their young; the reason being that, not having left the burrow before daylight, they are afraid to leave till evening. If they find their burrows disturbed they will not go in.

The Natives are very careful, when taking the young *Taikos*, not to disturb the burrows. They make expeditions in May to the islands where these Petrels are breeding. In former times each tribe had their ground, which they visited every year, and defended obstinately against the intruder. The birds were taken out with a flexible stick, pointed at one end and split, which was pushed into the burrow till the bird was felt, when they twisted the stick round in the down and pulled out the bird gently; then bit the head, to kill it. They then took the bird's bill, to cut the skin under the crop, and pulled out the

oil-bag, which was thrown away, as the oil would spoil the flesh for food. They pluck each bird as they get them, and when a large number are obtained carry them to the camp, where they singe the down off over a fire; then they roast the bird until the fat is extracted, and, placing them in a vessel made of totara bark, they cover them with the fat to keep them air-tight. When preserved in this manner they keep a length of time. I saw the Natives very often preserving them during my researches in the King Country, beginning of 1882; and have eaten and found them excellent. If the Natives disturb any of the Petrels' burrows, they always restore them. These birds, which were very numerous on the Little Barrier Island during the breeding season, I found on my last visit (April and May, 1885), had become very scarce, but I found the remains of many which pigs and dogs had destroyed.

I procured specimens, as you see here: adult, young of different ages, and egg.

Art. XIV.—*Observations on Gould's Petrel (Hutton)*, Procellaria gouldi (Ohi), *their Habits and Habitats.*

By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 27th July*, 1885.]

These Petrels are common on the coast of New Zealand. I saw them in large flocks out at sea, where they remain from March till August; in the latter month they come ashore to their old breeding places, which they use annually as long as they are not molested. These birds breed in colonies: their burrows are sometimes very close to one another; on the Little Barrier Island (or Hauturu Island) I measured a piece of ground 36 feet in circumference, in the centre of which were six burrows. Their breeding resorts are always on the cliffs along the coast, and some are very difficult to approach, dug out by these Petrels even in hard sandy formation or clay. In August, male and female begin to clean out their old burrows, or dig fresh ones if the former have been disturbed, in a similar manner to the *Procellaria parkinsoni.* The burrows are from 1½ feet to 4 feet apart; the entrance 6 to 10 inches in diameter, the passage in most cases winding, and from 2 to 4 feet deep. The chamber is from 1½ feet to 2 feet wide, and from 6 inches to 1 foot high; in it is a deepening, with a few leaves and grass, which forms the nest. In the beginning of September the female lays one white egg, the size of that of a common fowl; they very seldom lay two eggs. The female hatches the egg, and the male roams about the ocean in the daytime—sometimes I found them ashore, in a separate burrow from that of the female.

After sunset, thick clouds of these Petrels swarm round the cliffs, uttering the melancholy sound "*ohi! ohi!*" from which the Natives named it "*Ohi.*" Each one circles round its burrow several times before it goes down to it; then they stop for a moment before entering. These birds go to and from their burrows several times a night. When the young is hatched, the female stops for a few days with her chick in the burrow; after that both parents leave every morning before sunrise, and fly to their haunts on the ocean. Returning after sunset, they circle round the burrows, then swoop down to the entrance and call: when answered by the young bird, they enter. If both birds come to the burrow together, one stops outside till the other reappears. When feeding the young they make a whimpering noise. Male and female rear the young together, and defend them; but they are not so vicious as Parkinson's Petrel. In February the young are full-grown, and very fat; the Natives go to collect and preserve them, in the same manner as I have already described in a former paper.

If any of these birds have to be preserved for scientific purposes, great care must be taken to catch the bird by the bill, and hold it tight together until it is killed; then dry sand or earth must be put in the bill, and the neck tied with a string or flax. If these precautions are not taken the birds disgorge an oily substance at the intruder, and over their plumage, which renders them useless. The old birds do the same, if caught directly after their return from the ocean. This oily matter is mostly taken from the Octopus (cuttle-fish), of which I found the remains in their crops. When I was observing their breeding-place in 1882, on the Little Barrier, one of these birds went circling round, but on noticing me would not come down, and kept on calling. I heard the young bird answering from a burrow: when I approached she was instantly quiet. Being a beautiful moonlight night, I went a short distance away to watch. Presently the parents descended, stopped outside the entrance, and went away. The next night I went to my post early, so as to be there before the birds returned from the ocean. When they arrived they circled round as usual, swooped down, and entered the burrow. In July and August, 1882, hundreds of these Petrels were washed ashore on the islands on the East Coast, either dead or exhausted, and were eaten by the wild pigs. I dissected several, but I could not ascertain any other cause of death than the severe storms which raged previously. I never found these Petrels inland, and they have decreased in numbers. I even saw them rooted out by pigs and dogs, on the cliffs, where only narrow ledges led to them. I procured specimens, as you see here: adult, and young.

ART. XV.—*Observations on Cook's Petrel (Grey)*, Procellaria cooki (Ti Ti), *their Habits and Habitats.*

By A. REISCHEK, F.L.S.

[*Read before the Auckland Institute, 24 August*, 1885.]

THIS pretty little Petrel is not so common as the previous species, according to Dr. Buller, F.R.S., etc.; there have been only a few specimens obtained, and very little is known of their habits, but I have succeeded in observing them carefully. The first time I met with this bird was in December, 1880, on my second research at the Chickens or Morotiri Islands, on the western slope of the larger island, along with the Tuatara (*Sphenodon punctatum*), in one burrow. Professor von Haast, F.R.S., etc., read a paper of mine before the Philosophical Society, Christchurch, on the latter (see "Transactions, N.Z. Institute," vol. xiv). On the north-eastern portion, near the centre of the Little Barrier or Hauturu Island, in October, 1882, my dog set a burrow; and on digging into it, I was surprised at finding a pair of these Petrels also on this island; they came ashore to clean out their burrows, which process is accomplished with their bill and feet, as I have already described in a previous paper. I measured several of their burrows, and found the average width at the entrance from 4 inches to 6 inches in diameter, and from 4 to 8, and even 12, feet from the entrance to the chamber, of which I always found two in each burrow, and which were from 1 foot to 1½ feet long, 1 foot deep, and from 6 inches to 1 foot high; in each chamber is a hollow filled with leaves, moss, or fine grass. I found these burrows even in the stiffest clay, winding about roots and stones. I often worked half a day, and then had to give it up without success. Male and female mutually assist at cleaning out or making fresh burrows. After sunset they begin to call like "*ti, ti, ti*," repeated rapidly, which is the signal to assemble for their departure to their ocean haunts, from which they do not return till before sunrise; this process goes on nightly till their burrows are cleaned out and the nest made. I built a hut in the centre of the Little Barrier, near one of these burrows, on purpose to make a closer observation of these rare birds. The 1st November, when they returned as usual, early in the morning, I noticed that they made a peculiar noise in their burrows; in about half-an-hour one came out and stopped for a moment, then flew away, and did not return till after sunset, when he flew several times round above the burrow, and then went off again, not returning till next night, when he went into the burrow and made the same gurgling noise as before; after a while a bird came out and flew away, which returned before

sunrise and went into the burrow. After some time one came out, and again flew away. I then examined the burrow, and found a bird sitting on an egg; on dissecting the bird I found it was a female. I never found more than one egg, and always the female sitting on it; the male I have found not far off in a burrow by himself. When the young are hatched, male and female rear them together, and defend them pluckily; the young are full-grown in March, when the Natives collect them for food; the flesh of this species of petrel being the most esteemed by them.

When on shore, the habits of these birds are nocturnal; their breeding places are in the mountains in the interior, they do not breed in colonies as the previous species. When swooping through the air, they make a noise with their wings like the hiss of a bullet speeding through the air. On dissecting the crops of these Petrels I noticed a peculiarity: the absence of oily matter or remains of fish, which is common in most of the *Procellaria* family. I found animalculæ, minute seeds, and seaweed. In my opinion this Petrel is not destructive to fisheries.

The young of all the species of *Procellaria* could be made use of for food, if properly prepared. In former times the Natives had, to a great extent, to depend on these birds, and made long expeditions to collect them; the manner of which I have already described in a former paper read before this Institute. I am sorry to say I have found them every year decreasing. When I went on my seasonal researches on my last trip, 1885, on the Little Barrier, I could not see a single specimen of this Petrel; and of the other four species I found numerous on my first visit I found only a few, but plenty of remains such as wings, feathers, etc., destroyed by wild cats, Native dogs, and wild pigs. In former times the Natives protected their breeding places carefully; but now, as they have plenty of other food which is easier to be got, they are left to destruction in all the inhabited places. I procured a few specimens, as you see here: male, female, and egg.

ART. XVI.—*Observations on* Puffinus gavius (*Forst.*), *Rain-bird,* (Hakoakoa), *their Habits and Habitats.*

By A. REISCHEK, F.L.S.

[*Read before the Auckland Institute, 21st September,* 1885.]

THIS Puffin frequents the coast of New Zealand, especially that of the South Island, where I have seen them plentiful, but in the North it is not so common. The plumage of the whole

upper part, including wing and tail, is glossy brownish black, each feather lighter shafted, which is especially noticeable in the larger wing covers; side of the face and neck is greyish brown; throat and under-surface, white; eyes, black; feet, flesh colour, darker on the edge; webs, yellowish; upper part of the bill, blackish brown, lighter at the edges and tip.

The measurement of adult bird, from tip of bill to the end of the tail, is 14 inches. Wing, from flexor to the tips, 8·5; tail, 2·5; bill, from the gape, 1·75; tarsus, 1·5; middle toe, 2.

In December, 1880, I shot a pair of these Puffins, between Morotiri and Taranga Islands, and in the same month I found young birds on the larger Morotiri Island. In October, 1882, on the north-eastern portion of Hauturu Island, I found a female of *Puffinus gavius* sitting on an egg, and, at the same place, towards the end of November and early in December, I found young birds.

Puffinus gavius come on shore in September, to clean out their burrows or make fresh ones, which they accomplish by digging with the bill and extruding the refuse with their feet; they work during the day, and after sunset they leave for their ocean haunts, returning before sunrise. These birds breed in single pairs. The entrance of the burrow is from 4·5 inches in diameter; the distance to the chamber, from 1 foot 6 inches to 3 feet. The chamber is 1 foot 6 inches long, and about 1 foot 8 inches high; in this there is a deepening with a few leaves, on which, in October, the female lays a white egg, which is 2·35 inches in length, by 1·75. She hatches during the day, when the male is generally out at the ocean, from which he returns after sunset, when the female leaves for the haunts, returning before sunrise, continuing this process till the young birds are a few days old, when both parents absent themselves during the day, but return after sunset to feed their young with an oily substance or matter which they disgorge into their bills. The young birds are covered with darkish grey down, and are full-grown in March, when they leave the breeding resorts for the ocean. The Natives procure and use them for food. The adult bird makes a noise resembling the cackling of a fowl, especially before bad or wet weather, from which the natives name them *Hakoakoa;* and at such times, when the Natives hear this bird, they never venture out at sea in their canoes or boats.

Their enemies, besides man, are cats, dogs, and pigs. I procured a series of specimens, as you see here, for observation and examination.

ART. XVII.—*Observations on* Puffinus assimilis (*Gould*), Totorore, *their Habits and Habitats.*

By A. REISCHEK, F.L.S.

[*Read before the Auckland Institute, 21st September*, 1885.]

As far as I know, this species has not been previously recorded from New Zealand, I therefore devoted extra attention to it, during my seasonal researches from 1880 until 1885, to find out if it is distinct from any of the local species. The first time I met with this Puffin was in December, 1880, on Morotiri Island, in a burrow, together with the Tuatara lizard (*Sphenodon punctatum*); the lizard I found generally in the first chamber from the entrance, and the bird in the second. I have seen adult, young birds, and eggs, together with the Tuatara lizard, in a burrow.

On my return to Auckland, in 1881, T. Cheeseman, F.L.S., and I, examined these birds carefully, and found they were dissimilar to any of the Puffins already described in New Zealand, but agreed with the description and measurements of *Puffinus assimilis* (Gould) as given by Gould in his book, "Birds of Australia." He says, "the specimens I procured were caught on Norfolk Island, where it is said to breed, consequently the seas washing the eastern shores of Australia might be considered its native habitats; it is evidently the representative of *Puffinus obscurus*, of Europe. On my homeward voyage from Australia, I saw numerous examples, flying off to the north-eastern end of New Zealand, and this, I regret to say, is all the information I have to communicate respecting it."

As I had not sufficient knowledge and material then collected by my first observation, I determined to observe them carefully, and secure a series of specimens, which you see here, and which I have obtained in the past four years.

Puffinus assimilis (Gould).—This little bird comes ashore in October to clean out its burrows, or make fresh ones, which process male and female accomplish together, with their bills and feet. The entrance is from 4 inches in diameter, and from 3 to 4 feet to the chamber, sometimes in a winding direction. In most cases I have found two chambers, similar in size to those already described, in which there is a deepening, covered with a few leaves and grass, where the female lays, end of October or early in November, one white egg, 2·1 inches long, 1·3 wide. Both parents assist in hatching and rearing the young. Their habits, during the breeding season, are similar to those of the *Procellaridæ* family, previously fully described. The young birds are full-grown in February, when the Natives collect them for food, and they are delicious eating.

I saw these birds in considerable numbers during the breeding season, on the outlying islands off the East Coast, especially on the Morotiri group. The plumage of *Puffinus assimilis* (Gould), *Totorore*, adult, is: crown of the head, upper part, wing, and tail, sooty black; side of the face, throat, and under-surface, white; eyes, blueish black; tarsus, light flesh-colour, with a blueish tinge, yellowish at the webs. The measurement from tip of the bill to end of the tail is 11 inches; wings, from flexor, 7·5; tail, 2·75; tarsus, 1·38; middle toe, 1·75. From the foregoing it is obvious that this species differs in plumage and size from *Puffinus gavius*, also the egg. Seeing *Puffinus gavius* and *P. assimilis* in the distance on the ocean, they appear alike, but the flight of *P. assimilis* is more active. Another contrast between the two species is that while the down on the very young of *P. assimilis* is light grey, the throat, breast, abdomen, white, the down of *P. gavius* is altogether grey, of a darker colour. The measurement of skeleton of adults compared, show: *Puffinus assimilis* (Gould), *Totorore*, from tip of bill to vent, 9·1; wing, the whole length, 6·85; leg, 6·5; head, 2·6. *Puffinus gavius*, from tip of bill to vent, 11·5; wing, 8·5; leg, to tip of toe, 7; head, 3·1. The Natives call *P. assimilis* "*Totorore*," and *P. gavius*, "*Hakoakoa*." Having amassed the facts which I have given you, I placed them before Professor Thomas, F.L.S., and T. Cheeseman, F.L.S., and, after a careful examination of the specimens, they agreed with me that this is *Puffinus assimilis* (Gould), a new species to New Zealand, which I have the honour to add to the Ornithology of this country, raising the number to 177; I have also to acknowledge my indebtedness to the Right Rev. Dr. Cowie, Bishop of Auckland, who kindly lent me the illustrated part, fol. 7, Gould's "Birds of Australia," where there is a life-size coloured illustration of *Puffinus assimilis*, as you see here, with a series of specimens for examination.

Art. XVIII.—*Observations on the Habits of New Zealand Birds, their Usefulness or Destructiveness to the Country.*

By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 19th October*, 1885.]

Hieracidea novæ-zealandiæ, *Lath.*—Quail Hawk (*Kaiaia*).

Male and female of this species are similar in plumage, but the latter is larger in size. They prey on wild and domestic fowl, and are very destructive. I have often seen them swoop down on and kill wild pigeons, ducks, etc.

Hieracidea ferox, *Peal.*—Sparrow Hawk (*Karewarewa*).

This hawk is similar in plumage to the former, but differs in habit, and is smaller in size, the female being the larger. It inhabits the mountains, where the forest is low and dense, and I found both species on the West Coast, South Island. In November, 1882, when encamped in the centre of Hauturu Island, I often heard the cry of young hawks, which I followed on one occasion, but a precipice prevented me getting near. I then climbed a tree, and soon saw at a short distance below me, in the crown of a bushy tree, a nest with three young birds; but, though I tried to descend at several places, I was unable to get any foothold, so, to my great disappointment, had to abandon the attempt to get any closer. The old birds flew about very excitedly, sometimes past my head, and I shot the female a few days afterwards in the act of darting at a kaka. This hawk is very bold, and commits much havoc. I saw them catch fowls within three yards from me; and a Mr. Silver and the Natives told me that they lost as many as 100 fowls, ducks, and young turkeys in one season. They also prey on rats, mice, and lizards. It is gratifying that these two species of hawks are not common.

Circus gouldi, *Bonap.*—Swamp Hawk (*Kahu*).

This hawk is common everywhere, especially in the swamps and plains. It is very destructive, catching anything it can master, such as poultry, game, rats, etc., and I have been told that they even attack young lambs. They also feed on carrion and eggs, and have frequently robbed me of birds which I had shot and hid, but found on my return half devoured or removed.

Athene albifacies, *Grey.*—Laughing Owl (*Whekau*).

Owls are more useful than destructive; but this species I never saw in the North, or outlying islands, and in the South it is extremely rare, and preys mostly on rats.

Athene novæ-zealandiæ, *Gml.*—Morepork (*Ruru*).

This little owl is common everywhere. In the forests it prefers deep, dark gullies, hiding during the day in hollow trees, or between the thick foliage, and in caves; but in the evening, when it comes out to seek its food, its melancholy call, "more-pork," or "*ruru*," is heard. We can forgive it for catching a bird now and then, on account of the great number of rats, mice, and insects it destroys. On returning to the house of Mr. Wilson, Northern Wairoa, one bright moonlight night in 1879, I saw a Morepork swooping down; then heard a squeak; when suddenly it flew upwards, and let something drop, repeating this action several times, ultimately remaining on the ground for a time, and then flying away. On examining the spot, I found the skin, head, legs, and tail of a rat. In April,

1880, I shot a very pretty and rare variety of this owl, near Castle Hill, Coromandel, which is now in the valuable collection of New Zealand birds of J. C. Firth, Esq., Auckland. On dissecting a series of these birds, I always found numerous remains of rats and insects in their crops.

Stringops (*Kakapo*).

These birds are not destructive, as they feed on berries, moss, and Alpine vegetation. They have disappeared from the North Island and the northern portion of the South Island, and at present only inhabit a chain of mountains on the West Coast.

Psittacidæ.—Parrots.

The four species in New Zealand are only destructive when they are too numerous. During the fire in Oxford Forest, large flocks of *Platycercus novæ-zealandiæ*, Red-fronted Parrakeet (*Kakariki*), then *Platy. auriceps* (Yellow-fronted Parrakeet), came to Christchurch, destroying the fruit of orchards. They were so numerous, I could shoot them from the Museum, where several pairs bred under the roof. On the northern portion of the North Island these birds are getting very rare, except on the outlying islets.

Platycercus alpinus.—Alpine Parrakeet.

This pretty little Parrakeet I never found near a habitation, only on the mountains near the Alps, in low thick scrub; it is a rare bird. Its food consists of berries and seed.

Nestor (*Kaka*).

There are three species in New Zealand; two of them are more useful than destructive, as they destroy numerous insects and their larvæ, which they dig out of the ground or rotten wood with their strong bills; they also feed on berries and various seeds; but *Nestor notabilis* (Kea), which fed in former times on the same food as the previous one, has become now a bird of prey, and very destructive on sheep-stations. In the Province of Otago, the station-holders give a reward for the destruction of these birds. In 1878, a gentleman sent me a few Keas, just shot, to Christchurch, remarking, in his letter, they had destroyed several of his sheep. When I examined their crops, I found that they contained wool and fat. A Kea, which I had in confinement, preferred carnivorous to vegetable food. On several occasions I saw Keas sailing above sheep, and shot them on the carcase, from which I found they had extracted pieces of flesh. My opinion is that these birds became carnivorous through being numerous when sheep were introduced, and feeding on maggots, which soon appear on carcases of sheep dying on the runs, and have thus probably acquired such a liking for the fatty matter that it has emboldened them to attack live sheep, which they pick on the back near the kidneys, and thus destroy.

This species is more active than the former two. The flight and cry of the Kea is similar to that of the European Stone Eagle (*Aquila fulva*). I saw them often at a great height, sailing about, and then swooping down to the ground, where their movements are very clumsy. These birds prefer the higher regions near the glaciers, but in the winter, during the severe snow storms, they come lower down.

Ardea.—Heron (*Matuku*).

There are seven species in New Zealand, five of which feed mostly on fish. But *Ardea pœciloptila* (Common Bittern) is very useful in destroying numerous vermin. Dissecting a series, I have found in their crops remains of rats; even as many as five in one bird.

Ocydromus.—Wood-hen (*Weka*).

There are four species in New Zealand, which are destructive to young domestic and wild birds, and their eggs; but they are useful in destroying vermin, as I have seen them often digging in the ground and rotten wood for insects. They also destroy rats, of which I have found the remains in their crops. Near Lake Brunner, a prospector had a rat and Maori hen as pets, which would come every evening at tea-time to get their share, and each one came when called by its name. Sometimes these two quarrelled over food, and at last the Maori hen gave the rat such a peck on the head that he tumbled over dead.

Porphyrio melanotus, *Temm.*—Swamp-hen (*Pokako*).

These birds are destructive to agriculturists, when too numerous. As soon as the grain makes its appearance, they pull up the young shoots and eat them; consequently the farmers in Canterbury gave a reward for their destruction.

Sterna.—Sea Swallows (*Tara*).

Five species in New Zealand, which are destructive to small fish; but *Sterna antarctica* (Common Tern) I found as far as forty miles inland, following the plough, picking up the vermin, or sitting on the fences watching for them. The two species of *Podiceps*, found on the fresh-water lakes, feed mostly on small fish and various insects; they are not destructive, or do little harm, if not too numerous, as the lakes will not become overstocked where fish are introduced.

Dysporus serrator.—Gannet (*Takapu*).

These birds are very destructive to fish, which they devour in great numbers. It is amusing to watch a colony fishing near their breeding resorts, constantly swooping down and rising—they swoop with such force at their prey that the water splashes up several feet. I have often seen them catch so large a fish that they were unable to rise, and had to let it go.

PHALACROCORAX.—Shag (*Kawau*).

There are thirteen species in New Zealand, and all very destructive to fish, on which they prey, especially *Phalacrocorax novæ-hollandiæ* (Black Shag), *P. melanoleucus* (Frilled Shag), *P. brevirostris* (White-throated Shag), *P. varius* (Pied Shag), and *P. punctatus* (Spotted Shag), which I have often found in the inland bays, rivers, and lakes. They are expert divers, and very few fish escape them. On my visit at Mr. Buckland's station at Kaipara, in 1885, on which there are some very pretty fresh-water lakes of considerable size, I inquired of Mr. Drew, the manager, if they contained any fish. He told me they had put carp in, but never could see any. On the banks of one of these lakes is a breeding-place of *P. varius*. Mr. Drew kindly rowed us across to it, and we shot a number of shags. Mr. W. Phillipps sent his dog after a wounded one, but biting him he let it go; the shag then dived, and took him by the front paw, and would have drowned him had we not come to his assistance. On skinning and dissecting, I found numbers of carp in these birds: one measured ten inches. In lakes or rivers where salmon, trout, or carp are introduced some trees or branches should be put into quiet water, to form a shelter and protect the fish from the shags.

EUDYPTES.—Penguin.

There are nine species in New Zealand, which all prey on fish and crustacea, but the injury they do is not much felt, as they avoid inhabited places, and are mostly to be found on the outlying islets and rocks. The sea-birds on the New Zealand coast are more useful than destructive. The Natives in former times subsisted mostly on certain species, and made large expeditions to the islands where these birds breed, taking the young and eggs of the numerous species of *Procellaridæ* (Petrel family—thirty-one in New Zealand); their feathers and down are also useful.

LARIDÆ.—Seagulls.

There are five species in New Zealand; most of them are useful in picking up the drift along the shore. It can be forgiven the *Larus dominicanus* if she spys now and then an egg of other birds and eats it. The usefulness of these birds should be known to agriculturists, as *Larus bulleri*, and *L. scopulinus* (Mackerel-gull) follow the plough from morning till night, picking up all vermin, and also search in the meadows with the same object. When dissecting, I found as many as forty different kinds of grubs, worms, etc., in one crop. This pretty little gull should be protected everywhere. I shall now turn to the birds which are very useful to the country besides those already mentioned above; as partially so, they ought to be protected,

except for scientific purposes. Parents and school teachers should instruct their children and pupils not to molest these useful birds during the breeding season, or to destroy their nests for the mania of collecting their eggs or young. There are the museums, where local and foreign collections are represented for instruction, free to public inspection; and if the New Zealand birds are not protected, or insectivorous birds imported, the country will suffer and the beautiful forests will only resound with the humming of insects, instead of the melodious songs of the feathered inhabitants. Already several species have disappeared from the mainland, especially on the northern portion of the North Island, or are extremely rare, such as *Pogonornis cincta*, Stich-bird (*Tiora*); *Anthornis melanura*, Bell-bird (*Korimako*); *Orthonyx albicilla*, White-head (*Popokatea*); *Petroica longipes*, Wood-robin (*Totowai*); *Petroica* (*Toitoi*); Pied Tit (*Meromero*); *Creadion carunculatus*, Saddle-back (*Tieke*); *Turnagra hectori*, North Island Thrush (*Piopio*); *Stringops* (*Kakapo*); *Coturnix novæ-zealandiæ*, Quail; *Athene albifacies*, Laughing Owl (*Whekau*).

Halcyon vagans.—Kingfisher (*Kotare*).

This bird is very useful in destroying insects. It is very interesting to watch this bird in the breeding season, when boring its holes in rotten trees, which is accomplished with the bill, sitting on an opposite tree and darting at the place where it is intent on boring a hole, splint by splint, till he gets tired, when his mate begins to work. I saw them sometimes striking at a tree with such force that they got stuck, and had to twist about to extricate the bill. Near the nest they are very spiteful; anything passing the tree they dart at, and, owing to this habit, they sometimes kill young ducks or chickens if their nests are near a farm-house. I saw even dogs and cats with an eye destroyed by the Kingfisher's dart. I found their nests often several miles inland, away from any creeks or rivers, but during the winter they inhabit the seashore.

Meliphacidæ.—Honey-eaters.

There are three species in New Zealand. Every old settler will remember the clear notes of the Bell-bird (*Anthornis melanura*), or the mocking of the Tui (*Prosthemadera novæ-zealandiæ*). These birds are very useful, as they destroy numbers of insects during the breeding season.

Xenicus.—Wren, two species.

These birds, which are becoming very rare, live entirely on insects; also *Acanthisitta*, Rifleman (*Titipounamu*), which I saw from early morning until late at night, climbing up and down trees and branches investigating every crevice for insects.

ORTHONYX.—New Zealand Canary, two species (*Popokatea*).

These birds live mostly on insectivorous food.

SPHENŒACUS.—Swamp-bird, two species (*Kotata*).

When passing a swamp one will often hear a peculiar whistle, and very soon these inquisitive birds come so near, that it could be sometimes caught with the hand, were it not so cunning in secreting itself in the rushes. They live mostly on insects.

GERYGONE.—Warbler, three species (*Riroriro*).

They are insectivorous birds, their thrilling notes and artistic nest are well known.

PETROICA.—New Zealand Robin.

The five species of *Petroica* (New Zealand Robins) live entirely on insects; they are very tame birds. I had them several times sitting on the barrel of my gun when watching other birds, or picking up insects at my feet when digging, or chopping wood. The song is very melodious, especially that of *Petroica longipes* (North Island Wood Robin).

ANTHUS NOVÆ-ZEALANDIÆ.—Ground Lark (*Pihoihoi*).

This bird lives mostly on insects, also the two species of *Turnagra* (Thrush), which are getting very rare.

RHIPIDURA.—Fantail (*Piwakawaka*).

Everyone admires the two species of these fly-catchers, and their graceful evolutions in catching their prey, in the act of which, a snap of the bill can be distinctly heard. On the West Coast Sounds, where the sandflies are in myriads, I saw in the little clearing near the hut as many as twenty of these fly-catchers in pursuit of sandflies, from early morn till late at night.

GLAUCOPIS.—Crow, two species (*Kokako*).

These birds feed mostly on berries and young leaves; their notes are very melodious, similar to those of a flute. In the pairing season, the movements of the male are most amusing, with spread wings and tail, and outstretched neck, performing most extraordinary evolutions similar to dancing.

CREADION.—Saddleback, two species (*Tieke*).

They are very useful in destroying insects, picking them out of rotten wood and between the bark, similar to the Woodpecker; they also suck honey out of the blossoms.

HETERALOCHA.—Huia.

These are also insectivorous.

CUCULIDÆ.—Two species.

They lay their eggs in the nests of the Robins or Warblers, which have to collect insects from early morn till late at night to

appease the hunger of their foster offspring. These Cuckoos live entirely on insects.

Carpophaga novæ-zealandiæ.—Wood Pigeon (*Kuku*).

This pretty bird is getting scarcer every year, and is esteemed for its delicious flesh; it feeds on berries and young leaves.

Apteryx.—Kiwi.

The four species, which are getting very rare, especially *Apteryx australis* and *A. haastii*, as they have no defence against their numerous enemies, except by running and hiding in burrows. Their food consists of various insects and berries.

The Waders.

All the Waders—such as *Charadriadæ*, *Hæmatopi*, *Limicola*, *Tringa*, *Gallinago*, etc., which form a numerous family, there being twenty-two species in New Zealand—are esteemed for food when in season. Their food consists of *Crustacea* and *Mollusca*.

Rallidæ.—Land-rails, five species.

Anatidæ.—Ducks, nine species.

These are all useful for their flesh, down, and feathers. Their food consists of different plants, seeds, grass, growing in the water or on the edges; also of insects and vermin of all kinds which they can overpower.

If the insectivorous birds are not protected, the result will be disastrous, as I have seen on several occasions during my travels. On a first visit to a certain district everything looked nice and green, but on visiting six weeks later the same place, I was astonished to see only patches of sward here and there, and thousands of caterpillars, which destroyed the vegetation. In another place, besides the destruction of vegetation, the paper and paint on the walls in the house, even blankets and clothes, were gnawed by crickets. The numerous dogs, and even cats, of itinerant travellers and Natives, let at large, (the poor brutes often being obliged to procure their own subsistence, and sometimes being abandoned,) become wild, and prey on birds; but if stoats, ferrets, weasels, mongoose, and cats are turned out to destroy rabbits, it will be difficult to protect the birds, as these creatures destroy them, especially ground birds, such as kiwis, kakapos, wrens; and many other of these interesting birds peculiar to New Zealand must disappear, even from the solitudes. It should be remembered that some of these animals prefer their abode near a habitation, where they make much havoc amongst poultry, as they just kill as many as they can get hold of, without eating them. In the Old Country, I remember as many as over twenty fowls in one night were destroyed, and the eggs taken away from the brood hens, which were killed first; and in Austria we destroy these animals at every opportunity. They are very cunning,

and will not take poison while they can get live prey. Rabbits are much easier destroyed by shooting, netting, or bagging with ferrets, when the land becomes more closely settled. I feel sorry that in this colony there is not more interest taken in nature and its resources; I do not mean that people should follow it as a pursuit, but more as a recreation, in leisure time. Through the extermination of forests, birds are forced to disappear; and it is a waste of timber, where the soil is too poor for agriculture and pasture, to burn and destroy the young trees for the purpose of getting a few large ones, or kauri gum, all of which might be secured without this wanton destruction, and thus save the bush and its useful inhabitants, of which we could learn a great deal by observation.

Looking at the building of nests, how artistically some are made, as that of the *Gerygone* (Warblers), through which rain cannot penetrate! When building, the male of most birds carries the material, and the female builds the nest; and if not contented they pull it to pieces, and begin afresh. In hatching they assist each other, and as soon as the young are out of the eggs, the parents show great pleasure and anxiety. From sunrise to sunset they collect insects to feed their brood, and they destroy a vast number in a single day. Then, their language: each sound has a different meaning. When the young in the nest chirp, hearing the warning sound from their parents, they are immediately quiet; and when out of the nest, at the approach of danger, the old birds hide their young, which remain quiet and still till the parents decoy their enemies away. I noticed this to be often the case with *Anthornis* (Bell-bird). When the young are able to feed, the parents show them how to procure food. Birds of prey take their young, and teach them various evolutions in the air, how to swoop on their prey, and make them very precautious against enemies. I saw old birds often punishing their young, if they did not listen to their call. Insectivorous birds show their young how to procure insects, by investigating every crevice, turning over refuse on the ground to procure grubs, or picking them out of rotten wood. As soon as the young are old enough, they have to look out for themselves. They all have to work for their existence, and are not selfish. I saw, often, over a hundred birds, of four or five different species, feeding together, and very seldom noticed one deprive another of its food. In conclusion, I should respectfully urge the necessity of effort to preserve the useful birds of New Zealand, which are of so much importance to the colony; and if this paper is the means of inducing anyone to interest himself in that direction, I shall be well pleased.

Art. XIX.—*Notes on the Habits of some New Zealand Birds.* By A. Reischek, F.L.S.; communicated by Professor Parker.

[*Read before the Otago Institute, 11th August*, 1885.]

Ocydromus fuscus, *Dubus.*—Black Wood-hen (*Weka*).

I observed this bird during my stay at the West Coast Sounds, in 1884. I saw them mostly at dusk, roaming about stony river beds, seeking food; the numerous dead trees, which are swept down along the banks by floods, affording them hiding places. I have also seen them on the seashore, picking up mussels, crabs, &c., and on the mountains, as high as 3,000 feet above sea-level, but scarce. During the day, they conceal themselves under roots and in hollow trees, their hiding places having generally two or three entrances, so that in case of disturbance they can easily escape. I was amused once at seeing my dog digging vigilantly at a burrow, while the wood-hen was quietly stealing away. On the dog pursuing her, she dodged him in the coolest manner for nearly a quarter of an hour, by going under the trees, and always taking care to keep on the opposite side from that on which he was; but on my coming to the dog's assistance, she gave a shrill whistle, and ran quickly away. When undisturbed, these birds are very bold and tame.

I always make it a rule not to shoot or molest birds near my camp, so as to observe them, and listen to their sweet songs. At Dusky Sound, a shining black wood-hen came every morning and evening to my camp in the gorge, uttering a shrill whistle of one note, and, on my throwing her a piece of biscuit, she would pick it up, throwing it on the ground till it broke, and then eat it. She became so tame that she would walk round the dog, and come into the tent; and on a second visit to this camp, I found she still haunted the place. On the 25th April, at daylight, I was awakened by a noise, and, on looking up, saw one of these birds amusing itself with my slippers, but on my moving she retired. On the 21st August, early in the morning, I shot a specimen, which never moved when picked up. I tied a string round its legs, and hung it up, intending to skin it after breakfast; but on going to do so, to my astonishment the bird had disappeared. I sent the dog to find it, but he could not. On the 24th, I let the dog loose for a run. He went into the bush, and returned with a live wood-hen, which I found on skinning so riddled with shot, that I thought it wonderful it could have survived. On the 27th, I went late in the evening along the left side of the Sound to observe nocturnal birds. About fifty yards from shore, I saw a bird swimming, which I shot at, and my dog immediately

swam after, but on his approach it dived rapidly, coming always nearer the land, the dog being so close that I could not fire again. The bird managed to get ashore, and ran swiftly into the bush, the dog following; but in a short time he returned with a black wood-hen, which, on skinning next morning, I saw had a number of shot in the neck and body. I was surprised at these birds being such expert swimmers and divers. Sometimes they followed me long distances to the camp, and carried everything they could manage, such as spoons, knives, candles, etc., away, if I forgot to secure everything well. In September, during a severe thunder and snow storm, one of the black wood-hens actually came into the hut where I was working, to take shelter, and it stayed a considerable time.

The breeding season, Mr. Docherty told me, is in January, when they lay from two to three eggs. I saw in April two females, with three young birds each, fully feathered. They were duller in plumage and smaller in size than the parents. Male and female do not differ in plumage, but there is a slight difference in size, the latter being smaller. These birds vary much in plumage, but jet-black ones are rare. They come out from their hiding places in the evening, or on dull days, when one can hear their melancholy whistle, consisting of three notes, "*u*, *o*, *e*," especially before bad weather. Their movements are very quiet. They scratch with their legs, and pick with their bill in rotten wood or earth for insects, in a similar manner to the domestic fowls. They also prey on rats, young birds and their eggs, then lizards, fish, crustacea, and berries. These, with shells and small stones for digestion, I have found in their crops. I never saw these birds using their wings. When skinned they make delicious broth, also their meat is good to eat. I procured specimens.

Glaucopis cinerea, *Gml.*—Orange-wattled Crow (*Kokako*).

This species represents, in the South Island, the *Glaucopis wilsoni* of the North; but the plumage is a little lighter, a light slate color; and one-half of the wattle orange, the other, dark blue. The wattles of the young birds are smaller and much lighter. This bird haunts open places with low scrub. When I was on the West Coast, South Island, in 1877, I saw this bird on Arthur's Pass, about 3,000 feet above the sea-level, sitting on a stone a few feet in front of me. In January, 1878, on Mount Alexander, about 2,000 feet above the sea-level, I met it everywhere, hopping very swiftly amongst low scrub and stones. I also found it on the ranges on the left bank of the Teremakau River, but not so frequently, as they have a preference for certain localities. The shepherds have told me that these birds only come down to the lowlands during severe winters.

During my research in 1884, at the West Coast, South Island, I did not find these birds so plentiful. I saw them here near the sea shore, also up on the high ranges, especially on the outskirts of the forests, roaming about in pairs, ♂ and ♀, or with their brood, generally three in number. They are very tame, but, when disturbed, are adepts in the art of hiding, either under a limb in the fork of a tree, or between thick leaves. On one occasion, I observed a pair of these birds at Dusky Sound. One I shot; and, not noticing the other go away, I waited, and presently saw its head peeping out from behind the limb of a tree, then drawing it back; and, repeating this action several times, it eventually hopped out on the branch, looked about, and, noticing me, went away very quickly. The movements of this bird are exceedingly quick; but, from the construction of the wings, it is not able to fly far, and that only when in extremities. Male and female are inseparable; the male utters a very sweet whistle, consisting of six notes, as "*te, to, ta, tu, tu, tu*"; the call of the female is composed of five, as "*te, a, tu, tu, tu.*" At a distance it very much resembles the sound of the flute. At Milford Sound, in October, 1884, I shot a crow, and then concealed myself until its mate appeared, which it did in a very short time; and, to my astonishment, instead of flying away when it saw me, the poor thing went to its dead companion, hopping around and calling, evidently in a great state of agitation. I felt so much for this bird, that I was very sorry I had shot its mate, and let it go. The pairing season begins in October, when the male makes extraordinary evolutions before the female, similar to the European Wood Grouse (*Tetrao urogallus*). He bows his head about, spreads his wings, and erects and spreads his tail, making at the same time a gurgling noise. They build their nests in thick scrub, not far from the ground, of twigs and moss. In the beginning of December the female lays from two to three eggs. Mr. Docherty and Mr. Sutherland told me that they have found their eggs in December and January. The young birds are full-grown in May, but they remain with their parents until the pairing season. The scarcity of these birds near habitations is due to their confidence, through which they often fall a prey to cats and men, which are their worst enemies. They are rather dry for eating. Their food consists of berries and young leaves, which I have found in their crops. I procured specimens.

Art. XX.—*Observations on* Sphenodon punctatum, *Fringe-back Lizard* (*Tuatara*).

By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 21st September*, 1885.]

On this remarkable lizard I have already written and forwarded a paper to Dr. Julius von Haast, F.R.S., etc., which he read before the Philosophical Institute, Christchurch. (See "Trans. N.Z. Inst.," vol. xiv., 1881.) Since then I have had many further opportunities of observing them on various islands off the coast of New Zealand.

On the Morotiri Islands, I found them common, in burrows by themselves, but oftener with the *Procellaridæ*. On my first visit to Taranga Island, in 1880, I searched the southern and western portions without seeing a single specimen; and I also searched Hauturu Island in the same year, with a similar result. On my second visit to Taranga Island, when searching the rest of that island, at the north-eastern portion, my dog set at a small burrow, and on examining it, I found a fine specimen of *Tuatara*. Afterwards, at the same place, I examined a number of burrows, so small that *Procellaridæ* could not enter. Some had a small chamber, others none; but I never found more that one lizard in each. The entrance measured from 3 inches in diameter, the burrow from 2 feet to 4 feet long. The *Tuataras* must have excavated these burrows, as they were different in form from those in which the birds are found associated with them. These lizards vary in colour from those on the Morotiri Islands, being a more greenish grey, with light spots, as I have a similar specimen here for examination. I think Dr. W. Buller, F.R.S., described it as *Ginteri*. I long since maintained that these lizards burrow, when others expressed doubts about it; but during five years' observation, I found many proofs, which have fully confirmed my first description; even in confinement, in my possession, they burrow; and Professor Thomas has a number for observation, which burrow even in stiff clay.

A remarkable fact in connection with these lizards is, that on all the larger islands they live principally on insectivorous food, such as beetles, grubs, wetas, grasshoppers, flies, etc., which I found on dissecting. They are thus very useful in destroying these vermin, and it is a pity that they are extinct on the mainland. A. Grainger, Esq., had a *Tuatara* nearly a year in his garden, which made her abode under the aviary, coming out at night in search of food. I never found any remains of birds, on dissecting *Tuataras* on the larger islands, living in the same burrow with *Procellaridæ* and their eggs. I think where

insectivorous food is plentiful, which they prefer even in confinement, they will not prey on birds.

On my visit to Karewa Island, at the beginning of this year, with Professors Parker and Thomas, I saw many young birds with their heads off. Professor Thomas got one of these lizards with a bird in its mouth, and I followed one which had a bird of considerable size in its mouth; it tried to escape in a burrow, but got stuck at the entrance. They catch the bird by its head, and then chew until it is devoured. My opinion is that, as this island is so small, and these lizards so numerous, this is the reason they prey upon birds. They live there along with *Puffinus brevicaudus*, on which, though it is a digression, you will allow me to make a few remarks. This species of Puffin is numerous on Karewa during the breeding season. In the daytime only single specimens, and their young, remain on the island, but in the evening we saw flocks of thousands of these birds circling round the camp. They seemed rather surprised to find a solitary habitation occupied. After sunset they settled on the ground, in some places so thickly that one could hardly walk without treading on them; instead of going out of the way, they defended themselves by biting, they even came into our tent, and we were obliged to throw them out and shut it up; then they burrowed in underneath. When preparing tea, one gentleman had to watch and keep them off the fire, and, when frying fish, they actually walked through the frying-pan. The variety of their vocal powers was most amusing, and when they joined in chorus it was deafening. One night I went into the bush with a light for the purpose of observation: a whole flock of these birds flew at me and knocked the light out of my hand; I did not allow my dog to touch them; they went on his back, walked over him, and sat alongside of him. These birds are very vicious when molested. Leaving Karewa and coming back to Hauturu Island, on my second and seasonal researches, I examined the whole island; on the eastern part I found a few *Tuataras*, but they are very rare. These lizards differ from the common *Tuatara*, in colour, form, scales, and touch of the skin.

The colour of the common *Tuatara* (*Sphenodon punctatum*) is: top of head, upper part, and sides, from dark to greenish grey, spotted with greyish white; throat, slate grey; abdomen, greyish white; the claws are tinged with yellowish green. The crest on the nape and back is very prominent, the spines are softer and flat in form, the scales and skin are coarse to the touch. The size is according to the age, from 8 inches to 2 feet long; the head 2·5 inches in length, 1·25 in width; the front leg, 3·5 to the tip of toe; hind leg, 4·5. The brick-red variety, which I found on Hauturu Island: colour, top of the head, back, and sides, light brick-red with brown bars; an elongated brown band on each side of the neck; and over the chest, throat, sides of the face,

light grey, with seven rows of light dots; abdomen, fawn colour; a yellowish green ring round the eyes. The crest on the nape and back is small, the spines are small and round, the scales on the skin fine and soft to the touch. Measurement of adult: 1 foot 5 inches, total length; length of head, 2·5; width, 1 inch; front leg to the tip of toe, 3 inches; hind leg the same. It may be that this variety does not deserve to be ranked as a distinct species from the common *Tuatara*, but at the same time I think it a very well-marked local form, which has probably arisen during long isolation on Hauturu Island. In many respects this variety seems most distinct from the common *Tuatara*, the crest both on the nape and the back are much finer, the separate spines are round, not gently flattened as on the common species. The form of the head is more of an oval shape, the scales, including those at the sides of the body, are smaller, and softer to the touch, the colour markings are decidedly different from the common *Tuatara*. The difference in colour might be due to the lighter character of the soil on which they live, as I have often found with animals and birds.

Here I have a series of specimens for observation, which Professor Thomas, F.L.S., T. Cheeseman, F.L.S., and I, have examined carefully. These gentlemen agree with me in the general tenor of these remarks.

Art. XXI.—*Notes on the Habits of the Polecat, Ferret, Mongoose, Stoat, and Weasel.* By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 30th November,* 1885.]

Putorius putorius.—Polecat.

This animal is common in Europe, except North Russia and Lapland, and is found in Siberia, Kamtschatka, and Tartary. It frequents mountains, forests, plains, and settlements; and makes a comfortable nest of grass, moss, leaves, &c., in hollow trees, or under the roots; between rocks, thick scrub, or in burrows, which they excavate if unable to find any already available. In severe winters they come near settlements, where they take up their abode in hay or straw stacks, stone walls, or some unmolested places about farm-houses, where they make great havoc amongst the poultry and eggs; and in Austria a reward is offered for their destruction. They destroy all the small animals and birds which they are able to overpower, and are even dangerous to children.

At a place in Austria where they are numerous, on one occasion when I was out hunting, I disturbed a hiding-place of these animals amongst the rocks, from which four came out,

and, instead of attempting to escape, they defended themselves in a most plucky and aggressive manner, by biting at my boots and stick, until I had destroyed the last. Their movements are active, and they are good climbers, swimmers, and divers. The female, after a period of two months, brings forth from three to six young, which are full-grown in about four months.

PUTORIUS FURO.—Ferret.

These animals belong to the same class as the former, but are smaller in size and more delicate in organisation, and cannot stand cold climates. They were reared in confinement in ancient times, and are mentioned by Pliny. They are now used for destroying rabbits and rats; but they are almost as destructive as their ally the polecat to small animals, birds and their eggs. They increase rapidly, having from four to eight young at a time.

HERPESTES ICHNEUMON.—Mongoose (Pharoahan Rat).

These animals are useful in destroying snakes and vermin, but are very destructive to domestic and wild birds and their eggs, besides killing animals much larger than themselves through their cunning and activity. They destroy more than they eat, in most cases merely sucking the blood and devouring the brain. The Arabs and Egyptians hunt and destroy them at every opportunity. They are common in Africa, Egypt, and Barbary, inhabiting the lowlands, and generally near rivers, where they conceal themselves in burrows or thick undergrowth, from which they watch for their prey. There are several varieties and species belonging to this genus, whose habits are similar to the species already described.

MUSTELA ERMINEA.—Stoat, or Large Weasel.

This animal when full grown is about 14 inches in length, with a very slender body and short legs. The colour in summer is a reddish brown; throat, under-part, and inside the legs, white. In winter it changes to white, except the black brush on the tail. I have shot, on several occasions, piebald and spotted ones. They are very active, day and night; are expert in climbing, swimming, and even diving. Pursuing their prey stealthily, they make a final spring to secure it. I do not know any animal pluckier or more vicious than these: they attack and overpower animals three times their own size. If one cannot master its prey, on its making a hissing noise others come to its assistance to conquer the victim, biting at its throat till it succumbs. They even attack children, if they interfere with them. They are useful in destroying rats and mice, but do great harm amongst poultry, small animals, birds and their eggs. I know cases where they killed every fowl about the house, and pigeon in the cots, in one night.

These animals inhabit plains, mountains, and forests, hiding in burrows or under stones or in thick hedges; and I also found them in farm-houses, where they had a dry place of concealment, and where they make a nest of grass and moss to sleep.

In the month of June, in Austria, the female brings forth after five weeks from four to eight young, which she protects with great bravery. The family stay together till the winter.

Mustela vulgaris.—Common Weasel.

This pretty little animal has the same habits and habitats as its ally the stoat, and is not behind it in bloodthirstiness. If the larger carnivorous animals were as courageous and vicious as these, they would soon reduce materially the limits of animal life.

Art. XXII.—*The Protection of Native Birds.*

By Hugh Martin.

[*Read before the Nelson Philosophical Society, 2nd March,* 1885.]

Birds peculiar to New Zealand that should be preserved in island reserves:—

A.—Birds inhabiting the Mainland.

4. *Athene albifacies.*—Whekau, Laughing Owl. South Island, and Kaimanawa Range in North Island.

9. *Pogonornis cincta.*—Hihi, Matakiore, Stitchbird. North Island.

10. *Prosthemadera novæ-zealandiæ.*—Tui. Both Islands; also, Auckland and Chatham Islands.

11. *Anthornis melanura.*—Korimako. Both Islands, and Auckland Islands. Rare in many parts.

32. *Turnagra crassirostris.*—Piopio, Southern Thrush. South Island. Now rare, and in many parts extinct.

33. *T. hectori.*—Piopio, Northern Thrush. Southern part of North Island.

37. *Glaucopis wilsoni.*—Kokako, Blue-wattled Crow. North Island. Very irregular in distribution.

38. *G. cinerea.*—Kokako, Orange-wattled Crow. South Island. Very irregular in distribution.

40. *Creadion carunculatus.*—Tieke, Saddle-back. Both Islands. Flight feeble.

41. *Heteralocha acutirostris.*—Huia. South part of North Island, in Ruahine, Tararua, and Rimutaka Ranges.

42. *Stringops habroptilus.*—Kakapo. Both Islands and Chatham Islands. Incapable of flight. Very rare.

47. *Nestor meridionalis.*—Common Kaka. Both Islands.

49. *Nestor notabilis.*—Kea. South Island, in Alpine regions.
52. *Carpophaga novæ-zealandiæ.* — Kereru, Kuku, Pigeon. Both Islands, and Chatham Islands.
54. *Apteryx mantelli.*—Northern Kiwi.
56. *A. oweni.*—Grey Kiwi. Both Islands.
55. *A. australis.*—Southern Kiwi.
57. *A. haasti.*—Roaroa, Kiwi, Karuai. South Island, in Alpine regions.
85. *Ocydromus earli.*—Weka, Northern Wood-hen.
86. *O. australis.*—Weka, Southern Wood-hen.
87. *O. fuscus.*—Black Weka. West Coast of South Island.
88. *O. brachypterus.*—South Island.
93. *Ortygometra affinis.*—Koitareke, Water Crake. Both Islands. Extremely rare everywhere.
95. *Notornis mantelli.* — Takahe; Moho. Resolution and Secretary Islands; and at Barepatch, between Maruia and Upokororo Rivers, east of Lake Te Anau.
98. *Casarca variegata.*—Putangitangi, Paradise Duck. Both Islands.
100. *Anas chlorotis.*—Pateke, Brown Duck. Both Islands and Chatham Islands. A very indifferent flier.
102. *Rhynchaspis variegata.*—Kuruwhengi, Shoveller. Both Islands and Chatham Islands. Nowhere common.
103. *Hymenolaimus malacorhynchus.* — Whio, Blue Duck. Both Islands.
104. *Fuligula novæ-zealandiæ.*—Papango, Scaup, Black Teal. Both Islands. Flight very feeble.
108. *Podiceps rufipectus.* — Totokipio, Dabchick. Both Islands.

B.—BIRDS PECULIAR TO THE OFF ISLANDS.

12. *Anthornis melanocephala.*—Korimako. Chatham Islands.
83. *Gallinago aucklandica.*—Snipe. Auckland Islands.
89. *Cabalus (Rallus) modestus.*—Mangere Islands, Chatham Islands.
91. *Rallus dieffenbachii.*—Moeriki. Chatham Islands. Extremely rare, if not extinct. Perhaps identical with No. 89.
92. *Rallus brachipus.*—Auckland Islands.
106. *Mergus australis.*—Merganser. Auckland Islands. The only known Merganser in the Southern Hemisphere.

Cnemiornis calcitrans.—Tarepo. (Kaimanawa Range ?)
A large bird is mentioned in the Transactions of the N. Z. Institute by, I believe, Mr. T. Cockburn Hood, as having been killed by a settler's dogs; which bird, if I remember rightly, was supposed by the writer to be a Tarepo.

The birds that most need preservation may be included under the following heads :—

1. Rare birds, and those that are decreasing rapidly: *e.g.*, No. 4, Whekau; 32-3, Thrushes; 42, Kakapo; 54-7, Kiwis; 93, Water Crake; 95, Takahe; 102, Shoveller Duck.

2. Birds of local habitat, and those of irregular distribution: *e.g.*, Nos. 37–8, Kokako; 41, Huia; and those peculiar to the Auckland and Chatham Islands.

3. Birds that are incapable of flight, or whose flight is feeble: *e.g.*, No. 40, Saddle-back; 85–8, Weka; 100, Brown Duck; 104, Scaup.

As may be seen, these divisions run into one another, and include almost all the peculiar species enumerated here.

I have included the Kea, as I think it would be possible to preserve it in certain islands, such as the Aucklands, where it would be harmless, and useful to man. The Kaka, Pigeon, Paradise Duck, Brown Duck, Shoveller, Blue Duck, and Scaup, being peculiar to New Zealand, and also valuable game birds, merit preservation, even though abundant.

The thirty-six peculiar species of birds named in the above list are, of those enumerated in the "Handbook of the Birds of New Zealand, 1882," all that I believe it to be at once practicable and desirable to preserve in island reserves. I should have omitted the birds peculiar to the Auckland Islands, as being, from the nature of their habitat, in no danger of extinction, had I been certain that these islands are uninhabited, or likely to remain so. I omit the native Quail, as being probably extinct; but even if it still survives, the time and money that might be spent on it would be better employed in procuring specimens of the Takahe and other peculiarly New Zealand forms.

On the necessity of immediate and effectual measures for the preservation of all rare ground-birds, such as the Kiwis and Kakapo, I needly hardly remark; but two species, the Takahe (*Notornis*), and Tarepo (*Cnemiornis*), deserve particular notice. The Takahe measures 25 inches in length, the Tarepo, at least 5 feet in height; so that they are well worth preserving from any point of view. Generally speaking, experience proves that no one will refrain from killing any rare or strange bird, unless it can be made more to their interest to do so. As, with very few exceptions, rare birds, such as these, are always killed by the bird-hunters, miners, and others living in the back country, who alone have opportunities to obtain them, I would submit the following (especially to prevent their destruction), as being the only effectual means for obtaining live specimens of these and other rare birds:—a premium should be offered, in addition to whatever other means may be employed, for all specimens that can be procured of the rarer birds, especially of the wingless ones, payable only on the reception of the birds *alive and*

in good condition; the highest sum being offered for the largest species of birds. The same should also be offered for the discovery of new species, in order to save them from extinction. I suggest this in the belief that, if acted on without delay, it will ensure the preservation of various birds that otherwise will be lost; and particularly that, besides being in the end the cheapest as well as the most effectual way to procure the rarer species, (being made known to all throughout those parts where such birds do or may exist,) it is the only way to save the Takahe and other large birds, which would in every way be well worth all it might cost to preserve them. As there must be some delay in establishing reserves, it would perhaps be well for immediate measures to be taken to procure rare "wingless" birds, (lest when the reserves are ready it may be too late to procure them,) keeping them in confinement, under as natural conditions as possible. By the time the birds have been obtained the reserves should be ready for them. Very rare birds, such as the Takahe, should, however, be kept under special supervision (in islands), at least until they become abundant.

In regard to the nature of bird reserves, there can be no doubt but that islands isolated by the sea are most suitable for that purpose, as will appear from a consideration of the following points: The objects to be gained being the preservation *and increase* of curious and useful birds, to obtain this result it is obvious that they should be as much as is possible protected against the ravages of beasts of prey.

The beasts to which the destruction of the indigenous birds is chiefly due, are the rat, cat, dog, and pig, to which must now be added the ferret, stoat, weasel, and mongoose; and were it not for their ravages, it is not improbable that many birds now rare would be comparatively abundant, and that very few would be in imminent danger of extinction. As it is, any scheme for the preservation of native birds must provide against their intrusion into the bird reserves.

Granting that it is possible to effectually fence out dogs and pigs, there yet remain other beasts that are even more destructive, and which it is practically impossible to keep out by any artificial barriers. The rat, it is true, is everywhere, but, as I have elsewhere observed, it would be kept under in island reserves by the owls and wekas, there being only the natural increase to contend against, the water being an effectual barrier against the ingress of more, save by the agency of man; whereas on the mainland there can be no such protection. Similarly, the water would bar the ingress of cats, weasels, and ichneumons, which could not be done otherwise, except at the expenditure of very much time and money. Islands, on the other hand, have in their favour both economy and efficiency,

such as cannot be attained otherwise, besides the saving of time, which is of great importance. In regard to Resolution and Secretary Islands, there are three possible faults in them, which would impair or nullify their value for reserves: 1st, their roughness and size may preclude the exercise of due supervision over them; 2nd, their shores may be too close to that of the mainland, so that they may not have a sufficient breadth of water to keep out noxious beasts; 3rd, pigs, dogs, or cats may have run wild in them. This seems the strongest objection that could be raised, and would be conclusive against the choice of them for reserves; but the two former might be overcome. Apart from this last objection, these islands are peculiarly suitable for birds, such as pigeons, kakas, ducks, and particularly kiwis, that require a wide range. I have omitted certain sea-fowl from the foregoing list, as they would be better protected throughout New Zealand against all excessive and wanton destruction, particularly in the breeding places. The birds referred to are the Penguins, Puffins (*Shearwaters*), Gannet, and some species of Petrel.

Protection for these birds is desirable, because, like the Fulmar, Guillemot, and other sea-birds of the British Islands, they are of value for their flesh, skins, feathers, and eggs. The Penguins, some of which are peculiar to Campbell and Macquarie Islands, may be taken as the southern representatives of the Auks, one species (167, *Aptenodytes pennantii*), being comparable in size to the Great Auk (*Alca impennis*), which was formerly extremely abundant in the North Atlantic, but is now believed to be extinct, having been extirpated for the sake of its flesh and eggs.

I have not disregarded the possible change involved in the removal of birds from the mainland to islands, having indicated in a previous paper several points bearing on this question. These, however, may all be said to be reducible to one, that of the vegetation; and if this is in character and luxuriance like that of the parts from whence the birds are taken, there would probably be no further difficulty.

The presence or absence of various birds, named in this list, would be a good test of their fitness for this purpose. I may mention some reasons for preserving indigenous birds, to show that this is not a question of sentiment only. They are as follows:—

First, the preservation of the birds under conditions that will enable their habits to be studied, as could not otherwise be done.

Second, the increase of rare birds, so as to enable museums, etc., that could not otherwise obtain them, to be supplied with specimens. This use of reserves would have to be guarded with extreme care to prevent any abuse of it, lest any birds should be unduly reduced in numbers or exterminated thereby.

Third, the preservation of birds that are useful as game, or capable of domestication, particularly such as the Takahe, which

are extremely rare, and must without it become extinct. Many native birds, though but little regarded here, would be valued in other countries, having much more to recommend them than sundry English ones that have been introduced. It will, of course, be necessary to take precautions against trespassing and poaching, the worst poachers being the professional bird-collectors, (who are doing their best at present to exterminate the Kiwi,) sealers, and whalers. All birds being strictly preserved, except where over-abundant or otherwise detrimental to the increase of those which it is especially desired to preserve, the reserves would serve as refuges to many sea and shore birds, as well as to Herons and other birds of wide range.

Although, strictly speaking, beyond the scope of this paper, it will not, I hope, be deemed altogether out of place to say a few words on behalf of the Tuatara. This curious and unique lizard is quite extinct on the mainland, only surviving in certain islands, and being a rare and singular lizard it is well worth preserving.

Although reiterating previous remarks, I would again call attention to the necessity of immediate action, on account of the opening up of the back country, the rapid increase of population, and last, but by no means least, the introduction of the weazel and other vermin, which must on the mainland certainly lead to the destruction of all ground-birds, and probably waterfowl also, as these nest in places easily accessible to them.

The supplementary list includes certain birds which, for reasons before stated, are well worth preserving in reserves; but not being peculiar to New Zealand, are, therefore, of less importance :—

SUPPLEMENTARY LIST.

Birds not peculiar to New Zealand.

90. *Rallus philippensis.*—Mohopereru, Striped Rail. Both Islands; Australia, Polynesia, Celebes, and Philippines.

94. *Ortygometra tabuensis.*—Putoto, Swamp Crake. Both Islands; Australia, Tasmania, Polynesia. Sparingly dispersed throughout New Zealand.

96. *Porphyrio melanotus.*—Pukeko. Both Islands; Chatham Islands, Australia, Tasmania, New Caledonia.

99. *Querquedula gibberifrons.*—Tete, Little Teal. Both Islands; Australia, New Caledonia, Indian Archipelago.

101. *Anas superciliosa.*—Parera, Grey Duck. Both Islands; Chatham Islands; Australia, Tasmania, and Polynesia.

105. *Myroca australis.*—Karakahia, White-winged (white-eyed?) Duck. Both Islands; Australia.

107. *Podiceps cristatus.*—Crested Grebe. South Island; Australia, S. Africa, Asia, North America, Europe.

ART. XXIII.—*Notes on the Bones of a Species of* Sphenodon, (S. diversum, *Col.,*) *apparently distinct from the Species already known.* By WILLIAM COLENSO, F.L.S., etc.

[*Read before the Hawke's Bay Philosophical Institute, 14th December,* 1885.]

TOWARDS the end of November, 1885, I received a small parcel of little bones from Mr. Mills, of the wood and coal depôt in this town. It was brought to me by one of his workmen, who said, "they were that morning found in the quarry, while digging, at about forty-five feet below the surface." I was not very well at the time, but on looking at them, I soon saw they had belonged to some small reptile. They were in most excellent preservation, even to their minutest parts and finest processes, and were not fossilized; but, most unfortunately, they were very few of the whole skeleton. On making further inquiry during the afternoon, I found that "the quarry" (which I had supposed to be distant, on the west side of Scinde Island and near the harbour, where the larger quarries are,) was very near me, in Town Section No. 101, and opened on to Tennyson-street South. On hearing this, I called my man, (whom I could trust on such an errand,) and, showing him the little lot of bones, sent him to the quarry to see if he could find any more. On his return, he brought me three additional bones, two of them being the pelvis bones of the skeleton.

In more closely examining them on the following day, I was pretty sure they were bones of a small lizard, and probably a species of *Sphenodon*, but whether of the more common species, *S. punctatum*, or of some other species, I could not determine.

I had Dr. Newman's interesting account of his anatomy of a species of *Sphenodon*,* (*S. guntheri*, Buller,) but that treated chiefly on its muscles; and I had no works describing clearly the osteology of the *Sphenodon*, neither were there any in the library of the Hawke's Bay Philosophical Institute, save a partial drawing of its entire skull, in a plate in the "Zoology of the *Erebus* and *Terror* Voyage," but without letterpress or description.

Finding, however, that Dr. Günther's full and able description of the anatomy of *Sphenodon punctatum* was in the library of the Colonial Museum, where also was a preserved skeleton of the animal (mentioned by Dr. Newman in his paper referred to), I wrote to the Director of the Colonial Museum, Dr. Hector, for the loan of both skeleton and book, and very recently I have received both, for which kindness I wish to thank him.

* "Transactions N.Z. Inst.," vol. x., p. 222.

Being thus aided for my task, I was enabled to go to work, and to examine and study the few bones I had obtained; and in this short paper I give you the result.

As I said at the beginning, the bones, unfortunately, were few. The total number of whole bones and pieces was but forty-three, several being small chippy portions of the skull that had separated at their sutures; fortunately the jaws with their teeth were among them, and nearly entire. Then, as regards their bulk, a wine-glass would have contained them all. Their complete list, as far as I have been able to make them out (through shortness of time), will run as follow:—

1. *Of the Head:* 6 bones, containing the teeth, viz.:—2 *maxillary*, 2 *mandibles*, and 2 *maxillary-palatal*; also 1 *splenial*, and 1 *articular* (belonging to one of the mandibles), 1 *os quadratum*, and 1, the basal portion of the skull, with *exoccipital* and other bones attached; with a few small, thin, chip-like bones and fragments.

2. *Of the Fore-limb:* 1 *humerus*, 1 *ulna* (whole), and 1 *radius* (part only).

3. *Of the Vertebræ:* 9 joints.

4. *Of the Body:* 8 ribs (some broken), and the pair of *pelvis* bones.

There was also among them what appears to be the tarsus of some small bird, but broken.

I will now give a more particular description of those bones, showing where I have observed them to differ from those of *S. punctatum*, as given by Dr. Günther.

Before, however, that I describe its teeth, I should observe that this animal, like *S. punctatum* and a few others, is a true *Acrodont*; that is, it has no proper teeth set into proper (alveolar) sockets like those of other animals; but its teeth are composed of little bony points, arising from the bone of the jaw itself,* and are of various shapes and sizes, so that it is difficult sometimes to decide whether a tooth or a projection should be considered as one or as three, from the number of its sharp,

*To this, I may be permitted to add in a note, that I was the first to point out this curious novelty; and this I did first to Dr. Dieffenbach (in 1841), from my living specimen, which I had and kept alive for several months. Dr. Dieffenbach then resided at Paihia, Bay of Islands, very near me, and visited me frequently; Dr. Dieffenbach, also, having at that time received from me the very specimen which Dr. Günther has stated in his admirable Memoir as being the *first* one taken to England, and deposited by Dr. Dieffenbach in the British Museum. (This is extracted by Dr. Günther from Dr. Dieffenbach's early work on New Zealand, vol. ii., p. 205, in which work, however, my *quondam* friend omitted to mention how and when he received it, as well as several other similar matters relating to specimens of New Zealand natural history, the Maori language, customs, etc., etc. Dr. Dieffenbach never visited the East Coast of the North Island.)

tooth-like points.* The teeth are mostly broadly conical, especially the maxillary, with their tips truncated or flattened, as if worn; and all with an apparent longitudinal flaw, or crack, extending down the centre of the tooth. At the same time, it seems to me that the structure of the substance of the teeth, from their semi-pellucid appearance, is different from that of the common bone of the jaws.

I. *Of the Teeth*:—

1. The *maxillary*, or upper jaws: One contains 16, and one 17 teeth, of which the central ones are the largest; in this respect differing largely from *Sphenodon punctatum* (Günther's).

2. The *mandible, dentary*, or lower jaws: One contains 16 teeth, and a canine one at the anterior end of the jaw, with no space between them; and one contains 13 teeth with the canine one, and a space between them. These dentary teeth are alternately large and small.

3. The *palatine* teeth also vary in number. In the one, there are 8, and in the other 10, teeth, the anterior tooth being the largest. This one agrees with *S. punctatum* (Günther's).

4. The *intermaxillary* teeth (if there ever were any) are missing.

Here, I may observe, that Dr. Günther says of the teeth of *Sphenodon punctatum*:—"There are originally about 18 in each maxillary, and 11 in each palatine. However, those of the anterior half of the maxillary appear to be soon ground down to the alveolar edge. . . . The first palatine tooth is much stronger than, and separated by a short interspace from, the succeeding. . . . The alveolar edge of the mandible is polished, bearing about 16 teeth as long as the number is complete; but (as in the maxillary) the teeth are gradually lost from the front backwards." Dr. Günther has also given several drawings of the teeth and jaws of *Sphenodon punctatum*, of both old and young specimens, but none of them agree with these of this specimen.

II. *Of the Dental Bones*:—

1. The upper jaw contains 10 *foramina maxima superiora*: of these, Dr. Günther merely says that "they are present as in other lizards."

2. The lower jaw contains 6 to 7 *foramina mentalia*: in *S.*

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*As an apt illustration of this, I may here quote what Dr. Newman incidentally mentions in his paper above referred to:—"Drs. Günther and Knox disagree in the number of teeth assigned to each maxilla and palate, but this arises from the fact that Dr. Knox considers several of them complex teeth, while Dr. Günther counts each cone as a distinct tooth. Günther says there are about eighteen teeth in each maxilla, which Knox counts as six. I counted sixteen in mine, and thirteen on each palate."—(*l. c.*, p. 232.)

punctatum these latter "vary in number from 2 to 4, and are small." The additional large *foramen* between the dentary and articular bones, mentioned by Dr. Günther as being large in *Sphenodon punctatum*, is also found here in this specimen, and is very large. This lower jaw has lost its *coronoid*, which separated at the suture; the very small and splintery *splenial*, and *articular*, were also separated at their sutures, but these two were with the bones.

3. The *palatine*, with its additional row of bony teeth, is a highly curious bone; when this is fixed in its natural situation in the roof of the mouth, forming an extra line of teeth parallel with those of the upper jaw, the teeth of the lower jaw are so situated as to fall in, or close up, between those two lines.

III. *Of the Remaining Bones of the Skull*:—

1. The inner basal portion, with the *exoccipital* bones, is complete; these are, however, much smaller than those of *Sphenodon punctatum*, yet the occipital hole (*foramen magnum*) is considerably larger. There is a most peculiar isolated internal bone, arising centrally from above the anterior *hypapophysis* of *basis-phenoid*, and also the *pterygoid*; it is not thicker than a bristle, and about 4 lines long; it is semi-cylindrical, and curved upwards, and wonderfully preserved! There is no such a bone shown in Dr. Günther's careful and able dissections of the skull of *Sphenodon punctatum*; * but it exists, though smaller and stouter and scarcely seen, in the Wellington specimen (which is badly preserved).

2. The *os quadratum* (1 only) is much broader at the end than that of *Sphenodon punctatum*, as shown in Dr. Günther's plate; besides, the suture joining it to the *pterygoid* is of a different shape; it is also different from that of the Wellington specimen.

3. There are also a few other very small, thin bones, mere chips, separated at their sutures, and not yet ascertained.

IV. *Of the Fore-limb*:—

Of this, there are 1 *humerus*, 1 *ulna*, and 1 *radius*; the two former are whole, the latter broken. The *humerus* is very stout, and is a beautiful piece of mechanism. Dr. Günther gives no drawing of these bones (though he does of the adjoining *scapula* and *coracoid*), and says very little about them, save that "they are similar in form to those of other known genera of this family." These three bones resemble those of the Wellington skeleton as far as those can be seen.

V. *Of the Vertebræ*:—

1. There are only 9 joints; 4 *cervical*, of which one joint

* This bone, however, may have been referred to by Dr. Günther, in writing on the palate and its muscles, where he casually mentions "the long styliform process of the pterygoid and ectopterygoid." (*l. c.* p. 600.)

is the 2nd cervical; 3 *dorsal;* and 2 *caudal*, upper anterior. These are all much smaller, etc., than those (few) shown by Dr. Günther, especially the 2nd cervical.

VI. *Of the Remaining Bones of the Body:—*

1. There are 8 of the smaller ribs and portions of ribs, none being quite perfect. These are very much smaller than those shown of *Sphenodon punctatum*.

2. The pair complete of *pelvis* bones, which differ considerably from those of *Sphenodon punctatum* (as represented in the drawing), in wanting the "remarkably developed uncinate process of *os pubis*, in the middle of their anterior margin, and the still more prominent *tuberositas ischii*" of the posterior angle. Those processes, however, exist in this pair of pelvis bones, but they are smaller, and of a different shape; while those same bones in the Wellington specimen are very much larger and stouter every way.

I regret not having had more of the bones of this little animal, especially those of the upper and fore parts of the head, with the intermaxillary teeth; more of the fore-limb, also those of the hind-limb, and more joints of the vertebral column. Of these latter alone—which joints in *Sphenodon punctatum* amount to 63, all varying exceedingly with their position in the skeleton—there are in this small lot only nine joints, or one-seventh of the complete number!

The whole of the bones of this newly-found specimen are remarkably thin, almost papery (except those three of the fore-limb), and yet generally perfect, and not worn down by friction or wasting. Their thinness, combined with the more sound and larger teeth, serve to show that this animal must have been young, or, at all events, not a very old one; and yet the teeth are very far from approaching to those of a young one, as shown by Dr. Günther. Again, there is no comparison as to general appearance between these bones and those of the Wellington specimen, which are both larger and stouter, and apparently of a different substance. These bones must have belonged to a much smaller animal than either *Sphenodon punctatum* of Dr. Günther, or that of the Wellington skeleton. At the same time, it must not be overlooked that the *dentary* bone (or lower jaw) of this specimen is quite as large as that of *Sphenodon punctatum* of Dr. Günther, and a little longer than that of the Wellington one.

These bones are not fossilized, neither are they rotten, although so very thin. The old Maoris always said that the tuatara (*Sphenodon* sps.) formerly inhabited the headlands of the New Zealand coast (as well as the islets lying off it), which the finding of this specimen proves. The place where it was found is on the east side of the outer hill forming Scinde Island (Napier),

which originally formed a steep slope to the raised beach below. The remains were discovered at a depth of about 45 feet from the surface of the slope, and about 40 feet in from the base, in apparently undisturbed sandy loam. My own opinion is—from having, thirty to forty years ago, seen remarkably large and deep new rents and fissures in the sloping sides of our Hawke's Bay hills, caused by earthquakes, many of them afterwards closing up,—that anciently this little animal, at some such a season, fell into one of those deep rents, and so perished.

In conclusion, I may observe that Dr. Newman also says:—"Three species of *Sphenodon*, unlike in form and colour, have been discovered: 1. *Sphenodon punctatum*, black and spotted; 2. *S.* (unnamed), green and yellow; 3. *S. guntheri*, lighter. The dark form is found in the North, the intermediate at East Cape Islet, and the lighter form in the South. *S. punctatum* was the form so elaborately described by Dr. Günther. The other species have not been anatomically examined."*

Dr. Günther also mentions the possibility of there being two species, although, from the smallness of the material before him at that time (1867,) he does not support it.

Such, however, being the case, and these (few) bones not wholly agreeing with those of *Sphenodon punctatum*, I have named this species *Sphenodon diversum*, but only provisionally, as on further examination of both this and of better specimens, and a closer comparison of them with the bones of those two other specimens mentioned by Dr. Newman, may yet show that these belong to one of those two species.

P.S.—The ordinary meeting of the Hawke's Bay Philosophical Institute, to be held this evening, being the last for this season and year, I have been very desirous of bringing this paper before you, and have only been able to finish it this day.

ART. XXIV.—*A List of the Native Birds of the Petane District, Hawke's Bay, with Notes and Observations.*

BY A. HAMILTON, of Petane.

[*Read before the Hawke's Bay Philosophical Institute*, 1885.]

THE district over which the birds occur, enumerated in the following paper, may be defined as the country lying between the two rivers, the Tutaekuri and the Mohaka. Included between these natural boundaries will be found a great diversity of feeding ground for the various kinds of birds, the tidal flats and estuaries of the Inner Harbour of Napier, the river-beds of the

*l. c., pp. 222, 223.

Esk and its tributaries, the fern-covered hills near the Mohaka, and the bush at Pohue, with the smaller patches of bush still remaining in many places at the heads of valleys; all these combine to furnish a very fair proportion of genera and species. The beautiful bay itself is visited in stormy weather by a number of oceanic species, many of which still remain unrecorded. Much remains to be done in ascertaining the local distribution of our New Zealand birds, and, as a contribution to this end, it is hoped that this list may be of service.

1. Hieracidea novæ-zealandiæ, *Lath.*—Quail Hawk.

This beautiful little hawk is not at all common in the district. I have only seen it four times in six years. It is curious to find this bird so scarce, as it is rarely destroyed by man, and can scarcely have any natural enemies.

3. Circus gouldi, *Bonap.*—Harrier.

Now this species has been persecuted and destroyed in considerable numbers for many years past, by gun and trap, in the interests of imported game birds; and yet it is almost ubiquitous, and may be seen from sun-rise to sun-set sweeping in wide circles over the hills. The reward offered by the Acclimatization Society for their destruction caused the death of a very large number, their carrion-loving propensities bringing them to an ignominious fate in the rat-trap. The damage done to the game birds by hawks is, I am inclined to think, very small compared with the ravages of the cats which infest the country, and, to a lesser extent, by the weka (*Ocydromus*). That the hawk varies its diet by occasionally devouring eels I can affirm, having, as I found by reference to my notes, twice surprised hawks feeding on them in the bed of a shallow creek.

5. Athene novæ-zealandiæ, *Gml.*—Morepork.

8. Halcyon vagans, *Less.*—Kingfisher.

Builds, or rather makes its nesting-place, in sandy cliffs at the edge of the Petane river-bed. Last season there were five nests made in the face of a bank, the holes reminding one of the sand martins in England. The holes were about five feet from the base of the cliff, and penetrated to a depth of three feet, and contained on an average five eggs each. I am informed by a person who took some of the eggs, that there was a considerable range of variation in both size and shape.

During the breeding season we do not see much of these birds, but when the young brood are fledged—and especially if the weather be wet and the ground soft—they become one of the most obtrusive of our feathered friends. On several occasions I have seen kingfishers in the act of killing and eating mice, and instances have been reported of their killing small partly-fledged birds.

10. PROSTHEMADERA NOVÆ-ZEALANDIÆ, *Gml.*—Tui.

Frequent in the bush. Occasionally visiting the cultivated lands and the neighbourhood of the houses, when the blue gums are in flower.

13. ZOSTEROPS LATERALIS, *Lath.*—White-eye, Blight Bird.

One of our best friends, and abundant in all parts of the district. The history of the invasion of New Zealand by this bird is one of the most interesting chapters in our zoological record.

19. SPHENŒACUS PUNCTATUS, *Q. & G.*—Fern Bird.

The peculiar chirp of this lively little bird is yet to be heard among the tall fern, though it is not so plentiful as in days gone by. It is probably diminishing in numbers before the march of civilization.

22. GERYGONE FLAVIVENTRIS, *Gray.*—Warbler.

In every garden and grove of trees.

26. PETROICA TOITOI, *Less.*—Pied Tit.

28. PETROICA LONGIPES, *Less.*—Wood Robin.

31. ANTHUS NOVÆ-ZEALANDIÆ, *Gml.*—Lark.

An egg was found this year quite pink; three other eggs in the same nest were perfectly normal.

34. RHIPIDURA FLABELLIFERA, *Gml.*—Pied Fantail.

35. RHIPIDURA FULIGINOSA, *Sparrm.*—Black Fantail.

I obtained a specimen of this bird in the Pohue Bush, about 20 miles north of Napier, July 7th. I have seen it occasionally nearer Napier. In 1876 I got two or three in the Horokiwi District, near Wellington. Several other instances are recorded in the volumes of the Transactions; and probably it will be found that, though much more plentiful in the South Island, it should be considered a species common to both islands.

43. PLATYCERCUS NOVÆ-ZEALANDIÆ, *Sparrm.*—Parrakeet.

47. NESTOR MERIDIONALIS, *Gml.*—Kaka.

This bird, like the tui, comes down to the gum-trees when they are in flower. In the bush parts of the district it is common.

50. EUDYNAMIS TAITENSIS, *Sparrm.*—Long-tailed Cuckoo.

The long-tailed cuckoo pays us a yearly visit, and this season a solitary bird remained in the Petane Valley very much later than usual, as I saw it several times during the last week of March. Has any instance been recorded of its remaining in the country, or would this bird have to take its journey of 1,500 or 1,600 miles to the Society or Friendly Islands by itself?

51. Chrysococcyx lucidus, *Gml.*—Shining Cuckoo.

Our bronze cuckoo is always welcome as the herald "of sunny days to be," and has yet another claim upon us as a practical destroyer of some of our insect pests. Mr. Gilberd, of Taradale, has informed me that for some seasons past he has noticed these birds feeding on the different scales and blights so much dreaded by all horticulturists; and he is convinced that they do a large amount of good. It is well that the services thus rendered by our summer guest should be published abroad, as it may restrain the murderous instincts of some of those who, if they see a pretty bird, must needs immediately try and shoot it.

52. Carpophaga novæ-zealandiæ, *Gml.*—Pigeon.

54. Apteryx mantelli, *Bart.*

Two specimens were taken alive in the Pohue Bush in 1880, and I believe it is still to be found on the slopes of Maungaharuru.

59. Charadrius obscurus, *Gml.*—Red-breasted Plover.

60. Charadrius bicinctus, *Jard.*—Dotterel.

Breeds on the river-beds. The eggs vary considerably in density of marking.

65. Hæmatopus longirostris, *Viell.*—Red-bill.

66. Hæmatopus unicolor, *Forst.*—Black Red-bill.

Both of the Red-bills frequent the sandy shoals and banks near the Port Ahuriri bridge.

69. Ardea sacra, *Gml.*—Blue Heron.

Although this bird occurs plentifully both north and south of the bay, I have only seen one specimen, which was resting on the western spit.

71. Ardea pœciloptera, *Wagl.*—Bittern.

This noble bird is remarkably numerous in the lagoons and swamps of the district. I have frequently seen during this month (April) as many as nine in sight at one time in the lagoon by the side of the Taupo Road, at Petane. Some years ago, when shooting at Tongoio, I put up sixteen in one day.

75. Limosa baueri, *Naum.*—Godwit.

79. Himantopus leucocephalus, *Gould.*—Pied Stilt.

80. Himantopus novæ-zealandiæ, *Gould.*—Black Stilt.

Both of these occur very plentifully, and breed on the islands in the harbour and on the river-beds. The vigilance of these birds is extremely annoying when in pursuit of ducks, as their harsh note of warning is quickly appreciated by any ducks in the neighbourhood.

81. HIMANTOPUS ALBICOLLIS, *Buller*.—White-necked Stilt.

Occurs not unfrequently.

85. OCYDROMUS EARLI, *Gray*.—Wood-hen.

Has increased very much in numbers within the last four or five years, and more especially near the swampy estuaries of the harbour. A nest taken November 10th contained four eggs, and the female bird caught on the nest contained another egg fully developed. The nest was simply a heap of dead grass under a rush bush, in a brackish water swamp.

90. RALLUS PHILIPPENSIS, *Linn*.—Striped Rail.

This elegant Rail is more plentiful in this district than I have seen it in any other part of New Zealand, excepting, perhaps, Okarito. The large rush-covered marshes near the mouth of the Petane River seem its chief stronghold. On the 14th March, this year, I caught, with the help of my dog, a female, and one out of a family of five chicks. The young were about half-fledged, and were most curious little things. I exhibited to this Society last year the egg of this bird.

93. ORTYGOMETRA AFFINIS, *Gray*.—Water Crake.

A cat belonging to a neighbour has brought me in, during the years 1881–83, seventeen specimens of this Crake, and twelve specimens of the next species (*O. tabuensis*). Both of these birds abound in the raupo swamps of the district, but are extremely difficult to obtain, unless a friendly "mouser" takes the matter in hand.

94. ORTYGOMETRA TABUENSIS, *Gml*.—Swamp Crake.

96. PORPHYRIO MELANOTUS, *Temm*.—Swamp Hen.

98. CASARCA VARIEGATA, *Gml*.—Paradise Duck.

Bred two years ago, in a swamp in the Petane Valley.

100. ANAS CHLOROTIS, *Gray*.—Brown Duck.

101. ANAS SUPERCILIOSA, *Gml*.—Grey Duck.

Has been crossed with the domestic duck by a gentleman living in the district, as recorded in the Transactions.

102. RHYNCHASPIS VARIEGATA, *Gould*.—Shoveller, or Spoonbill.

This beautiful species is not at all uncommon about the district. Indeed, I think that in some seasons I have shot as many Spoonbills as Grey Ducks, probably owing to their being more easily approached.

103. HYMENOLÆMUS MALACORHYNCHUS, *Gml*.—Blue Duck.

104. FULIGULA NOVÆ-ZEALANDIÆ, *Gml*.—Black Teal.

108. PODICEPS RUFIPECTUS, *Gray*.—Dab-chick.

Several pairs of these pretty birds breed every year in the Tongoio Lagoon. In March last, I watched for some time a

family party, the two old birds and four young ones, preening their feathers in the sun, and keeping together in a most sociable manner.

111. Larus dominicanus, *Licht.*—Black-backed Gull.

112. Larus scopulinus, *Forst.*—Mackerel Gull.

114. Sterna caspia, *Pall.*—Large Tern.

115. Sterna frontalis, *Gray.*—Sea Swallow.

116. Sterna antarctica, *Forst.*—Common Tern.

117. Sterna nereis, *Gould.*—Little Tern.

Only after or during heavy weather.

119. Diomedea exulans, *L.*

120. Diomedea melanophrys, *Boie.*—Mollymawk.

One picked up on the Tongoio beach, March, 1884.

129. Puffinus brevicaudus, *Brandt.*

130. Puffinus tristis, *Forst.*—Mutton Bird.

138. Procellaria fuliginosa, *Kuhl.*—Sooty Petrel.

143. Prion turtur, *Sol.*—Dove Petrel.

144. Prion vittatus, *Gml.*—Broad-billed Dove Petrel.

149. Dysporus serrator, *Banks.*—Gannet.

150. Phalacrocorax novæ-hollandiæ, *Gould.*—Black Shag.

This bird is at present a proscribed individual, a reward of 1s. 6d. being offered for every head.

156. Phalacrocorax brevirostris, *Gould.*—White-throated Shag.

This small Shag breeds in trees by the side of the Petane River, some distance above the confluence of the Kaiwaka Stream.

159. Phalacrocorax punctatus, *Sparrm.*—Spotted Shag.

Of the Spotted Shag, I have seen but two specimens in the harbour; one was shot at Kaierero in 1882.

169. Eudyptes pachyrhynchus.—Crested Penguin.

175. Eudyptula minor, (?) *Forst.*

I saw one swimming in the surf in January, 1884. Very scarce on this coast.

ART. XXV.—*A remarkable Variety of the New Zealand Pigeon* (Carpophaga novæ-zealandiæ), *with References to previous Notices.* By T. W. KIRK.

[*Read before the Wellington Philosophical Society, 24th June,* 1885.]

HEAD, neck, and fore part of breast, which in ordinary specimens are shining gold-green, are here thickly strewn with white feathers. On the fore-neck, the coppery purple band is replaced by a large patch of pure white feathers. The nape, shoulder, and upper surface of wings are also thickly strewn with white feathers; back and uropygium have likewise many white patches, but getting fewer towards the latter portion. The bright green of the breast is succeeded by a band of pale grey, which fades as it approaches the abdomen. Quills and tail-feathers, normal colour. In no instance is a parti-coloured feather to be found, the white feathers being pure; even the shafts are destitute of colour.

Eyes, pink, not carmine-red, as is usual. Feet, paler than customary; the soles flesh colour, rather than yellow. Bill, normal colour.

This specimen was shot at Eketahuna, in the Seventy-mile Bush, Provincial District of Wellington, by Mr. R. R. Greville, and by him presented to the Museum.

References.—Buller, "Birds of N.Z.," p. 158; "Trans. N.Z. Inst.," vol. viii., p. 196.

Kirk, T. W., "Trans. N.Z. Inst.," vol. xii., p. 248.

ART. XXVI.—*Notice of an Instance of Abnormal Colouring in* Platycercus auriceps, *with Record of previous Notices of similar Variations.* By T. W. KIRK.

[*Read before the Wellington Philosophical Society, 24th June,* 1885.]

ON looking for previous notices of the occurrence of variations from the type of this species, they were found to be so scattered, that the thought struck me it might be of some help to students of ornithology if they were collected together into one paper. I have therefore prepared the description of the specimen now on the table, with a record of all previous notices that I could find; and trust that the list is tolerably complete.

1. Mr. H. H. Travers (see "Trans. N.Z. Inst.," v., p. 216, 1872), in a paper on the Birds of the Chatham Islands, says: "I obtained a specimen on Mangare with a faint yellow tinge on the head."

2. Mr. Potts ("Trans. N.Z. Inst.," vi., p. 148, 1873): "A specimen with yellow plumage."

3. Dr. Buller ("Birds of N.Z.," p. 61) describes three instances:—

(*a*) A young bird taken from the nest, "and not fully fledged, had the plumage of the body pale yellow, shaded with green on the upper parts, and the quills and tail-feathers marked with red."

(*b*) "Another had numerous light crescentic marks on the wing-coverts."

(*c*) The third, captured in the Manawatu, had quite a dazzling combination of colours: "Frontal band, crimson; vertex, golden yellow; space round the eyes, and a band encircling the neck, green; head, shoulders, and lower part of back, red, and the intermediate space variegated with red and green; quills dusky, obscurely banded with yellow, and margined on the outer web with blue; wing-coverts greenish yellow, barred and margined with red; tail feathers green, obscurely barred with yellow in their apical portion; under-parts green, variegated with crimson and yellow; an interrupted band of the former colour crossing the breast."

This specimen was kept in confinement, and during the moulting season was fast losing its distinctive colouring, when it was accidentally killed.

4. The sixth example is the specimen now before you. The general plumage is of a beautiful canary yellow. A band of dark crimson connects the eyes, passing across the forehead just above the base of the bill. The crimson spot on either side of the uropygium is larger and much more brilliant than in the normal specimen. Quills and tail-feathers yellow, but with patches of blue, green, and dark brown, except the under tail-feathers, which are a rich yellow; shafts of all feathers white. On raising the feather the underneath downy portions are seen to be pure white, instead of blueish slate, as is usual. Bill, white; feet, yellow; legs normal colour.

This beautiful specimen was captured at Takaka by Mr. Fabian, telegraph lineman, in whose possession it was seen by Dr. Lemon, to whose intercession the Museum is indebted for the donation.

ART. XXVII.—*On the Habits of* Ocydromus australis.

By W. W. SMITH.

Communicated by Dr. Buller, C.M.G., F.R.S.

[*Read before the Wellington Philosophical Society, 25th November, 1885.*]

IN offering some observations on the South Island Weka, I desire to lay before the Society some account of the habits of this interesting and useful species, as it exists at present in the more settled districts. It is undeniable, and certainly to be deplored, that in some localities this valuable bird is rapidly disappearing; not, however, from natural causes, as want of food or shelter, but from the manner it is assailed and destroyed by man, impelled by an ignorant and mistaken prejudice. Too much cannot be said in favour of the Weka, and all prejudice would soon be overcome, as anyone who would give a little attention to its habits could soon observe. The mere destruction of a few eggs in or near the poultry yard, or disturbing a few pheasants in reserves, may be overlooked, compared to the inestimable services they render in destroying vermin.

The Weka's "struggle for existence" is greater than any other native bird. Thousands perish annually in the fires which sweep over large areas of tussock lands. It is mercilessly destroyed with dog and gun, while numbers fall victims to poisoned meats, laid for hawks; but the most deadly enemies it will now have to contend with are the recently-introduced stoats and weasels; and if these voracious and nimble little mammals flourish in our country, not many generations will elapse before the "last of the Wekas" shall be recorded.

In cultivated districts they are more wary and more nocturnal in their habits, generally remaining concealed during the day in gorse hedges, patches of scrub, or swamp, or in plantations of English trees. In the evening they leave these haunts and roam over the fields, feeding chiefly on worms, which they draw from their burrows and consume in large numbers. They are of great service to the squatters and farmers in consuming the larvæ of *Odontria*, which devastate lawns and English grass paddocks. The larvæ live beneath the surface of the soil, subsisting on the roots of grasses. The roots are eaten close to the surface, leaving the plant to shrivel and die, or to be blown away by the wind. In the morning large patches may be seen fresh turned over during the night, by the Weka digging out and consuming them. When a brood is hatched near paddocks infested with these grubs, the parent birds lead them there, and dig vigorously over the ground, rooting them out with their powerful bill to feed their young. If encouraged about homesteads, they are heard during the night tapping on the walls of dwelling and

out-houses, picking off the spiders and insects secreted there; when bags or sheepskins are found lying on the ground, they drag away or turn them over, to procure the worms, beetles, or woodlice hidden beneath. Occasionally, during their nocturnal rambles, they discover the carcase of a sheep; they commence pulling off the wool until they effect an opening in the flesh; here they fare sumptuously for weeks, often secreting themselves in the nearest cover, and returning night after night to feed on the carcase, or the maggots, which in their turn devour it. They are also expert destroyers of rats and mice, and assist materially in destroying the numbers of young rabbits in infected districts.

The omnivorous habits of the Weka favour it more than any other native species to withstand the change produced by cultivation. It would survive when all other known species of Rail would soon become extinct. It is equally at home among cultivated gardens and fields, as well as in its native tussock, swamp, or bush.

The call is an excellent barometer; but the call which indicates rain is readily distinguishable from its ordinary answering call—it is more incessant, and repeated at shorter intervals. The ordinary call, or cry, is invariably led off by the female, and is answered in all directions by both sexes. This, however, is only peculiar to paired birds before or after meeting, as the male or female is often heard, solitary, answering others in the distance, while its mate is on the nest. The preparation of the ground, gathering of the tussock grass, and building of the nest is performed by both birds alike. They are fastidious in their choice of a site, going over the same spot many times before it is selected. The nest is placed under a tussock (*Poa*) or niggerhead (*Carex virgata*); it is found in clumps of *Discaria toumatou* and *Pteris aquilina*, and I have seen it twice placed under a bare rock, but the gorse hedge is preferred, as affording better protection from the attacks of dogs. One I observed last year, made by a half-tame pair, was completed in two days. The grass is placed in a loose heap on the spot selected; the nest is shaped by the bird squatting on the material, and turning round until a hollow is made; it then draws the grass around its body with the under surface of the lower mandible until it is completed. After the completion of the nest alluded to, one day elapsed before laying; one egg was then laid each successive morning; when it contained four, they began to hatch, the female generally remaining a little longer on the eggs than the male. At this season they have a muttering or suppressed call; if the sound is carefully imitated, it is an easy matter to find a weka's nest, provided it is approached cautiously, or unperceived by the birds. When a nest is found, the finder may rest assured there is not another near for a considerable

distance. The young make their appearance on the twentieth day, and remain in the nest three or four days before the mother ventures out with them; the chicks are shy and wary, and hide on the slightest alarm given by the parent birds. The male is untiring in its efforts to procure food, and often rambles far from the brood; when a suitable morsel is found it runs hurriedly back to them. The morsel, whatever it may be, is usually seized by the female while in its mate's bill. Often enough food for days is strewn around the brood, so persistent is the male in its efforts to procure food. Both parents are furious in defence of their young; if a chick is caught, and caused to make a distressing cry, both birds rush around with open beak, and utter a barking discordant noise. I have often seized both birds with my hands by this means.

The young attain maturity in the fifth and sixth month; they are deserted by the parent birds about the fourth month, the latter generally laying again and rearing a second brood; if the nest is robbed, or the young removed from them, they will lay three and four times. Eggs and young can be obtained in this district (Oamaru) all the year round. The Weka's age can be determined by the colour of the eye, the legs, or plumage. The bright scarlet iris is acquired the second year; the silvery plumage of males, or the bright red legs of females, is an unmistakable sign of good age in both. Once paired, they will remain permanently so.

When enclosed in small yards they become tamer than domestic fowls, thrusting their heads through the meshes of the wire and feeding from the hand. For two seasons I have confined female wekas with domestic game-cocks, for the purpose, if possible, of procuring hybrids between the two species, to endeavour to settle the question of alleged crossing, but thus far without success; although they lay freely, the eggs have been unfruitful. If the eggs are removed immediately after laying, they lay four and five times during the year, producing fifteen or twenty eggs.* The wing-spurs appear to have been acquired for defensive purposes alone, as I am unable to detect any other purpose they serve in the bird's economy. The females do not use the spurs much, one or other generally running away, hotly pursued by its assailant. The chase is often kept up till both are exhausted. The males are more pugnacious, and do not run so readily. When fighting, and facing each other, the wings are elevated or arched over the back, the neck is drawn in under cover of the wings, while the spurs are

* This season, three young females, reared in confinement, have laid seven dozen and two eggs, one bird laying three dozen and two of this number; the latter from the first week in September to the present time, December 7. The two others laid two dozen and three from August 25th, and one dozen and nine from August 28th, respectively.

pointed forwards. During a combat they injure most the back of the head. If examined after it, they are found to be wounded only on the head and neck. Along with the bruises produced by the hard bill are punctures caused by the wing-spurs. The latter are always more numerous at the base of the bill, and about the eyes, rarely extending down the neck. For a few days after the battle the head is swollen and hard, the neck is stiff and carried forward, but when near abundance of cold water they soon recover.

I know several authentic instances of the wekas' thievish tricks; one will suffice to show how dearly it pays at times for some inquisitive freaks of its nature. Six years ago a weka entered a bushman's hut in Peel Forest, during his absence. After springing on to the table it tasted the meat, the butter, and bread, and ungratefully tumbled the remainder on to the floor, endeavouring no doubt to carry them off. Failing this, it took with it, as the bushman asserted, "one of a new pair of Sunday boots." Although the loss of food, or injury to the carpet or crockery was small, and the new Sunday boot left only a few paces from the door, the bushman was avenged. In less than a month after the occurrence, he informed me, with his dog and gun he had killed forty wekas.

It is melancholy to notice the species disappearing from districts where only a few years ago it existed plentifully. Its presence is a boon to agriculture, and I trust the good qualities I have mentioned will commend the weka to the protection of the colonists.

Art XXVIII.—*Description of Hybrid Ducks, bred from Common Duck* (A. boschus) ♀ *and Grey Duck* (A. superciliosa) ♂.

By Taylor White, Glengarrie, Napier.

[*Read before the Hawke's Bay Philosophical Institute,* 1885.]

About nine years ago the grey drake (*A. superciliosa*) was trapped in the Wakatip Lake District, and readily became tame, but was very shy with strangers. In the third spring it paired with a domestic duck (*A. boschus*). A brood of six hybrids were reared.

No. 1. These mainly partook in type of the domestic duck, but were smaller, more plump in shape; colour, a creamy brown with darker markings, inclining to white on lower part of breast, throat, and cheek; a dark line passing through the eye, as in *A. superciliosa*; beak, brownish yellow; legs, dull yellow; speculum blue, outer black, margined with white, as in domestic duck. The drakes very similar to English wild duck (*A. boschus*), and having the curled tail-feathers; speculum, blue. Could fly fairly well, but with reluctance.

No. 2. One of these half-bred ducks mated with a grey drake (*A. superciliosa*), and one duck was reared, which in colour and size was almost identical with *A. superciliosa*, but had the speculum green, margined with white, and a slight touch of white on some of the secondary feathers of wing. Could fly strongly.

No. 3. This duck, when mated with a grey drake (*A. superciliosa*), produced a brood in type and colour like *A. superciliosa*, some of which have reverted to a wild state. For several seasons the first brood have been all dark-coloured, and the second brood always includes pure white, or albinos, and white with markings of dark pencillings and rufous; speculum, green; dark-coloured bill and legs; curled tail-feathers wanting.

No. 4. A drake, bred *inter se*, might be described as in foundation colour like *A. superciliosa*; slightly tinged on head with green; light colour on cheeks, dark mark through eyes; breast, rufous; speculum, green; tail, and tail coverts, inclining to black, edged with brown; two small curled feathers in tail.

No. 5. This season, in a brood of six, reared by a hybrid duck, which might be easily mistaken for a coloured call duck, which was mated to *A. superciliosa*. The ducks were slightly larger than *A. superciliosa*; foundation colour and markings similar, having a washed-out look; sides of breast forward of thigh, white grey, same as lower part of breast of *A. boschus*. Bill, some blackish green; legs the same. Others, bill yellow, chequered with black; legs, yellowish black; speculum, green, outer edge black, margined with white band above and below. The drake was identical in general appearance to *Anas boschus:* green head, white ring on front of neck, one curled tail-feather only. Colour of speculum, green, margined with white. Can fly, but are thoroughly domestic. As in the mallard, the bright colouring changes with the seasons.

The hybrids lay twice in the season, but few young are reared owing to want of convenient water; and numbers are destroyed by dogs, cats, hawks, and rats. The latter are very destructive.

ART. XXIX.—*Note on a large Sun-Fish* (Orthagoriscus mola, L.), *recently captured at Napier, Hawke's Bay.*

By A. HAMILTON, of Petane.

[*Read before the Hawke's Bay Philosophical Society, 8th June, 1885.*]

A FINE Sun-Fish (*Orthagoriscus mola*, L.) was recently thrown on shore, close to the Port of Napier, in a dying condition; I was fortunate enough to see it soon afterwards, and took measurements and sketches of all the important features. I also

took steps to secure the skin for stuffing, and, in the course of removing the skin, the men who did the work cut the greater part of the body to pieces, and they brought me some very curious teeth which they obtained a considerable distance down the throat, and, as far as I can learn, immediately between the branchial openings. The teeth were about one inch in length, the upper portion slightly curved, longitudinally striated, and gradually diminishing in diameter from the base to a sharp point. There were three rows of these teeth on each side of the pharynx, and the numbers may be expressed thus: 7, 9, 6, and 8, 9, 6. Three of these teeth are clearly accidental, one on the first row of the one side, and two on the first row of the other side, thus leaving the formula 6, 9, 6 and 6, 9, 6. The teeth are immovably fixed in solid cartilage, and when fresh there was between each row a thick fleshy gum or pad, which nearly covered the teeth.

Pharyngeal teeth are not uncommon in fishes, but I have not been able to find any mention of them in the Sun-Fish or other *Gymnodonts*. Another observation may, perhaps, be interesting. When I examined this fish on the beach, the surface of both jaws was covered with a kind of enamel, and felt perfectly smooth to the touch. When I received the skin, and had leisure to examine it closely, I found that rough handling, owing to the huge size and weight, had caused the enamel to scale off, and had left the jaws, which were now rough, presenting a surface resembling the shagreen of the dermal papillæ; but at the back edge of both upper and lower jaws were the original teeth of the fish, in size and shape much resembling grains of rice. These, I find from books, are serviceable in the earlier life of the fish, but when it attains a large size, these are absorbed (or are said to be). They seem, however, to be simply left behind by the growth of a broad horizontal layer of calcified tissue, which is covered on the top with a thin coat of enamel.

The great size of this specimen, 8 feet 1½ inches in length, and 5 feet 6 inches in depth, not including the dorsal and anal fins, would probably indicate an advanced age. The bony osselets, which are said to carry a spine in young specimens, were present, but their presence could not be detected in the living state. They were about the size of a duck egg.

Postscript.—A specimen of the Spinous Shark (*Echinorhinus spinosus*) has been captured in Hawke's Bay this month (September, 1885); it has been previously recorded in New Zealand waters by Prof. Parker, "Trans. N. Z. Inst.," vol. xvi., p. 280.

ART. XXX.—*On a New Species of* Chromodoris.

By T. F. CHEESEMAN, F.L.S.

[*Read before the Auckland Institute, 1st June, 1885.*]

A FEW months ago, Captain Farquhar, of the steamer *Clansman*, very kindly brought to the Auckland Museum a living specimen of an exceedingly handsome *Nudibranch*, found by him on the rocks at Whangaroa Harbour. Since then I have also had specimens in alcohol, of the same species, sent to me from Whangarei Heads. It proves to be undescribed, and to belong to the genus *Chromodoris*, of which only one species was previously known to inhabit our coasts—viz., *C. aureo-marginata**, a pretty little animal occasionally seen in Auckland Harbour. Captain Farquhar's species is larger, and much more brightly and vividly coloured. The following is a description :—

Chromodoris amœna, n. sp. Body $1\frac{1}{2}$ to 2 inches long, linear-oblong, rounded in front, pointed behind, back slightly convex. Mantle smaller than the foot, quite smooth and even, pale pinkish or purplish lilac, with a central row of large bright orange oblong spots, and occasionally a few lateral ones, margin pale creamy or yellowish white. Dorsal tentacles (*rhinophores*) clavate, completely retractile within slightly raised sheaths; upper part arched backwards, laminate, laminæ from 24 to 25. Branchiæ completely retractile, 10 in number, connected at the base, small, erect, linear, simply pinnate. Both tentacles and branchiæ are a bright magenta colour. Oral tentacles free, small, conical. Foot paler than the mantle, the sides and extremity with an irregular double row of roundish bright orange spots, considerably longer than the mantle; sole, pale flesh-colour. Odontophore of about 65 rows of teeth; central tooth small, laterals from 60 to 70 on each side. Mantle spicules apparently wanting. Ova deposited in a spiral coil of four turns.

Captain Farquhar's specimen lived in confinement for more than a month, during this period depositing its ova. It was lively and active in its habits, and was fond of floating in a reversed position just under the surface of the water, as is the case with many of the *Nudibranchs*. Its graceful form and bright colours render it one of the handsomest species yet discovered in New Zealand.

* "Trans. N.Z. Inst.," vol. xiii., p. 223.

Art. XXXI.—*On a new Paper Nautilus* (Argonauta bulleri).

By T. W. Kirk.

[*Read before the Wellington Philosophical Society, 24th June*, 1885.]

Plate IV.

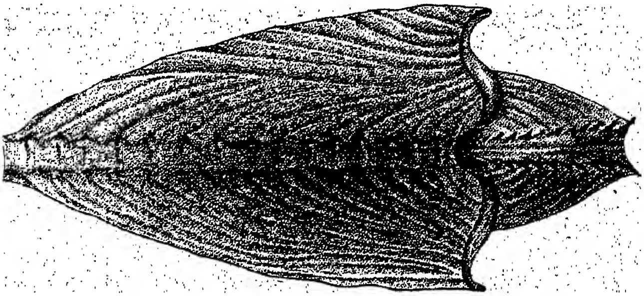
It may be remembered that last year I had the pleasure of exhibiting quite a fleet of "paper nautilus," and of describing a new species (*A. gracilis*), for several specimens of which I was indebted to Mr. C. H. Robson, of Portland Island. That gentleman then informed me that he believed there was a third species on the New Zealand coast, but that he had never been able to obtain a perfect specimen. In the "New Zealand Journal of Science" for May, 1884, he mentions having obtained a perfect shell; and in a letter lately received he says: "I told you of a supposed new species of *Argonaut*, found by me on Portland Island in March, 1884. . . . I will ask you to examine, describe, and name the specimen which I now forward to you. If it is new, I should like it named after our mutual friend Dr. Buller, who, notwithstanding all he has done for the natural history of New Zealand, has only one bird dedicated to him. . . . For some time before I obtained the shell which you will receive, I felt sure that a third species visited our shores, having found fragments of shells which did not seem to belong either to *A. tuberculata* or *A. gracilis;* but on account of the fragility of the shells in question, the pieces were always too small for practical use, till I obtained the nearly perfect specimen which you will receive, and which you will at a glance perceive is quite distinct from either of the two species above named. I wish to present it to the Colonial Museum, if new, as a type specimen."

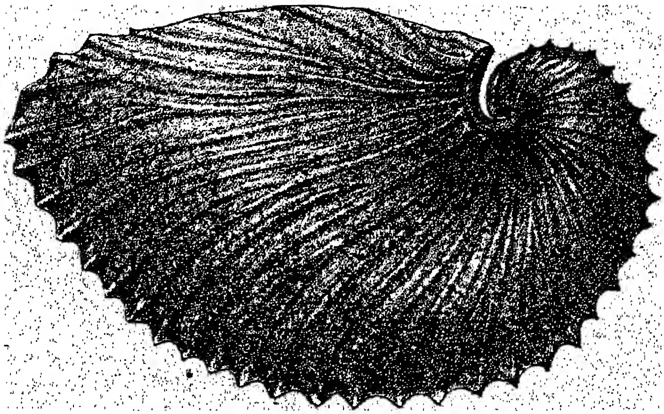
As I have no doubt about its being a new species, I have great pleasure in complying with the discoverer's wish, and naming it after New Zealand's premier ornithologist.

Description.—Shell translucent, sides much compressed, especially towards the keel, giving the aperture a hastate shape; sides with numerous transverse plications, which are *not* tuberculiferous, sides project near the spire into wing-like processes, similar to those of *A. tuberculata*, causing this end of the aperture to look nearly straight. Keels very close together, with small compressed tubercles; colour, white.

Loc.—Portland Island.

This shell is very much thinner, more fragile, and of finer texture even than *A. gracilis*, and may be distinguished by the general form of the shell, the shape of the aperture, the angle at which the wings spring from the sides, the much narrower space between the keels, and by the plications being true, not





ARGONAUTA BULLERI. n. sp.

made up of numerous tubercles as is the case with *A. tuberculata* (Shaw), and *A. gracilis* (*mihi.*) The nearest species is apparently *A. argo*, from which it is distinguished by the wing-like processes and other minor differences.

ART. XXXII.—*Description of a new Pill-Millipede.*

By T. W. KIRK.

[*Read before the Wellington Philosophical Society, 23rd September*, 1885.]

THE *Myriapoda* have occasioned much diversity of opinion amongst naturalists in time gone by. Some have classed them with insects, some with spiders, and some with Crustacea, for they possess characters allied to each of these; but the distinction of a separate class is now generally accorded them, and this class is divided into four orders. I. *Chilopoda*, contains the carnivorous centipedes. II. *Chilognatha*, the vegetable-eating millipedes (*Iulidæ*), the gallyworms (*Polydesmus*), and the pill-millipedes. III. The third order was created for the reception of a peculiar little animal, one-twentieth of an inch in length, which possessed characters totally different from those of any member of the two orders previously mentioned. This little creature was discovered and described by Sir J. Lubbock. IV. The fourth order contains that extraordinary genus of animals found in the West Indies, South America, South Africa, and New Zealand; I refer to the *Peripatus*. So puzzling are the characters presented by this genus, that it has been at different times referred to the errant *annelids*, the leeches, the tape-worms and the *Myriapoda*; in the last-mentioned it remains for the present. And though its position is by no means satisfactory, it yet appears to be more nearly related to the *Myriapods* than to any other group.

The animal to be noticed this evening belongs to the second order, or vegetable-eating millipedes, and will be called *Sphærotherium novæ-zealandiæ*.

SPHÆROTHERIUM.

The segments resemble those of *Glomeris*, but are fourteen in number, including the head, and twenty-one pairs of legs. Eyes grouped together, and situate on an eminence on each side of the head, just above the insertion of the antennæ.

Sphærotherium novæ-zealandiæ.

Head, coarsely punctured, especially near anterior margin, which is notched in the centre, and strengthened by a ridge, immediately behind which is a transverse groove, and in front a number of yellow and brown hairs; the groove and the space around is closely but coarsely punctured, the punctures becoming much more distant as the posterior margin is approached.

Nuchal Plate.—Anterior margin strengthened by a ridge, produced in the centre, but slightly depressed on superior surface; posterior margin rounded; entire but somewhat irregular.

Dorsal Plates.—Smooth, highly polished. First dorsal segment with a very strong lateral ridge, continued up the anterior margin beyond its articulation with the nuchal plate; in the depression immediately behind the ridge are a number of coarse punctures; a shallow transverse depression about one-third of the distance from anterior margin; the anterior lateral margins very obtusely rounded; the plate produced backwards, so that if the line of junction between the first and second segments was continued, the portion cut off would be nearly semicircular. Last dorsal segment arched, margin entire, sharp, a wide shallow depression immediately inside the margin, expanding upwards at both ends. Intermediate segments smooth above, with the margin rounded in front and pointed behind; strengthened by a ridge, and with a triangular excavation at the anterior angle, most distinct in the fifth and ninth segments; a few yellow hairs in, and a prominent oblong tubercle just above and in front of, each excavation, especially noticeable in fifth to ninth segments. First dorsal segment widest; 2nd to 6th about even; 7th wider; 8th to 11th about even.

Colour.—Light brown, marbled with darker.

Length, 1·35; breadth, ·8; width of head, ·4; depth of head, ·25.

Habitat.—Tinakori Hills, Rimutaka Mountains, Wellington; Stratford, New Plymouth. The specimens from Stratford were presented by Mr. A. Burrell.

No representative of this genus is found in England, but an allied though much smaller form, the common pill-millipede (*Glomeris marginata*), may be seen in almost every English garden; and in old times, both it and the armadillo wood-louse were used in medicine, and may still be found amongst the old stock of some druggists' shops, probably because when rolled up they look like pills—hence the name; and when coated with gum and flour and taken with sufficient faith they were considered very efficacious in various complaints.

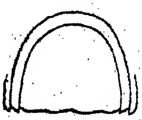


Fig. 3.

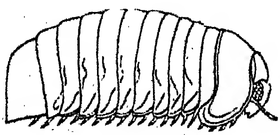


Fig. 1.

Fig. 2.

1. Profile. 2. Head, nuchal plate, and first segment, front view. 3. Last two dorsal segments from behind.

ART. XXXIII.—*Critical List of the* Crustacea Malacostraca *of New Zealand.* By GEO. M. THOMSON, F.L.S., and CHAS. CHILTON, M.A.*

PART I.

[*Read before the Otago Institute, 10th November,* 1885.]

WITHIN the last few years considerable additions have been made to our knowledge of New Zealand *Crustacea,* especially in the *Amphipoda* and *Isopoda,* and as the literature of the subject has become already somewhat scattered, we have thought it advisable to draw up the following concise list, which we think will prove serviceable to students of Carcinology. The synonymy of most of the species is not given in detail, as such a course would unnecessarily swell out the list, but it is as complete as is needed. The distribution in the colony of each species is given as far as it is known.

It is probable that, as a result of renewed and more detailed examination, some of the species here enumerated will have to be struck out, particularly when more attention has been given to the development and metamorphoses of the individuals, and to the sexual differences. At the same time the number of species yet to be described must be very large. One can hardly make a collection, particularly of *Amphipoda,* in any part of New Zealand, without coming across new and distinct forms; and when more systematic dredging is carried out than has hitherto been attempted, the number of such undescribed forms will be materially increased.

NOTE.—Following Professor von Martens' suggestion, the specific name *neo-zelanicus* has been adopted in place of all the various forms of the word meaning "of" or "from New Zealand."

Crustacea Malacostraca.

Order I.—ARTHROSTACA.

Sub-order I. Amphipoda.

Tribe I. Læmodipoda.

1. CAPRELLINA LONGICOLLIS.

Caprella longicollis. Bate (Cat. Brit. Mus. Amph., p. 362, pl. 57, fig. 4).

Caprellina novæ-zealandiæ, Thomson (Trans. N.Z. Inst., vol. xi., p. 247).

Caprellina longicollis, Mayer (Caprelliden d. Golfes Neapel, p. 27).

Hab. Stewart Island, Dunedin, Oamaru, G.M.T.; Timaru, Lyttelton, C.C. (Chili.)

* While quite prepared to take my full share of responsibility for this paper, I wish to state that the whole work of preparing it has been done by Mr. Thomson. I have simply gone over his manuscript, adding fresh localities, and making a few suggestions and additions here and there.—C. C.

2. Caprella aequilibra.

Caprella aequilibra, Say (Journ. Acad. Philad. i.). Bate (Cat. Brit. Mus. Amph., p. 362, pl. 57, fig. 5). Mayer (Capr. d. G. Neapel, p. 45).

Caprella caudata, Thomson (Trans. N.Z. Inst., vol. xi., p. 246).

Caprella novæ-zealandiæ, Kirk (Trans. N.Z. Inst., vol. xi., p. 392).

Caprella obesa, Haswell (Cat. Austral. Crust., p. 314).

Hab. Dunedin, Oamaru, G.M.T.; Lyttelton, C.C.; Cook Strait, T. W. Kirk. (N. S. Wales, Japan, China, Brazil, South Carolina, Europe.)

3. Caprella linearis.

Caprella linearis, Bate (Brit. Mus., Cat. Amph., p. 353, pl. 55, fig. 17). Mayer (Capr. d. G. Neapel, p. 58).

Caprella lobata, Kirk (Trans. N.Z. Inst., vol. xi., p. 393).

Hab. Cook Strait, T. W. Kirk. (Europe, East Coast of North America.)

4. Cyamus ceti.

Cyamus ceti, Martens (Voy. Spitzbergen, 1671), etc., etc. Chilton (Trans. N.Z. Inst., vol. xvi. p. 252).

Hab. Parasitic on whales (*Virgia breviceps*), C.C. It appears to be common on various whales (and sharks ?). I have it from several localities in the New Zealand seas, G.M.T. On small hump-backed whale, Napier, A. Hamilton.

Tribe II. Crevettina.

Fam. I. Corophiidæ.

5. Corophium contractum.

Corophium contractum, Stimpson (Proc. Acad. Nat. Sc. Phil., 1855). Bate (Brit. Mus. Cat. Amph., p. 282). Thomson (Ann. and Mag. Nat. Hist., 5, vol. vi., p. 6; Trans. N.Z. Inst., vol. xiii, p. 220, pl. viii).

Hab. Dunedin, G.M.T.; Lyttelton, C.C. (Japan.)

6. Corophium crassicorne.

Corophium crassicorne, Bruzelius (Skand. Amph. Gam., p. 15, pl. i., fig. 2). Bate (Brit. Mus. Cat. Amph., p. 282, pl. 47, fig. 6).

Hab. Lyttelton, C.C. (Norway, Britain.)

[This species is taken along with *C. contractum*, and it is probable that they are only male and female of the same species. *C. Bonnellii* (Milne-Edwards) is probably the same as *C. contractum*.—C.C.]

7. COROPHIUM EXCAVATUM.

Corophium excavatum, Thomson (Trans. N.Z. Inst., vol. xvi., p. 236, pl. 12, figs. 1–8).

Hab. Brighton, near Dunedin, G.M.T.

8. COROPHIUM BARBIMANUM.

Gammarus barbimanus, Thomson (Trans. N.Z. Inst., vol. xi., p. 241).

Corophium lendenfeldi, Chilton (Trans. N.Z. Inst., vol. xvi., p. 262, pl. 20, fig. 1).

Haplocheira typica, Haswell (Proc. Linn. Soc. N.S.W., vol. x., p. 273, p. xi.).

Hab. Dunedin ? (specimen in the Otago Museum without locality,) G.M.T. ; Lyttelton, C.C. (Sydney, Haswell.)

9. CYRTOPHIUM CRISTATUM.

Cyrtophium cristatum, Thomson (Ann. and Mag. Nat. Hist. 5, vol. iv., p. 331, pl. 16, figs. 9–15).

Hab. Dunedin, G.M.T.; Lyttelton, C.C.

10. PODOCERUS FREQUENS.

Podocerus frequens, Chilton (Trans. N.Z. Inst., xv., p. 85, pl. 3, fig. 2).

Hab. Lyttelton, C.C.

11. PODOCERUS LONGIMANUS.

Podocerus cylindricus, Kirk (Trans. N.Z. Inst., vol. xi., p. 402). Not of Say.

Wyvillea longimanus, Haswell (Proc. Linn. Soc. N.S.W., vol. iv., p. 336, pl. 22, fig. 7).

Podocerus longimanus, Chilton (Trans. N.Z. Inst., vol. xvi., p. 255, pl. 17, fig. 2).

Hab. Lyttelton, C.C.; Wellington, T. W. Kirk. (Port Jackson.)

12. PODOCERUS LATIPES.

Podocerus latipes, Chilton (Trans. N.Z. Inst., vol. xvi, p. 258, pl. 19, fig. 2).

Hab. Lyttelton, C.C.

13. PODOCERUS VALIDUS.

Cyrtophium validum, Dana (U.S. Explor. Exped., p. 841, pl. 56, fig. 2).

Podocerus validus, Bate (Brit. Mus. Cat. Amph., p. 253, pl. 43, fig. 9.) See also N.Z. Journal of Science, vol. i., p. 517.

Hab. Dunedin, G.M.T. Lyttelton, C.C. (Rio Janeiro.)

14. Paranænia typica.

Paranænia typica, Chilton (Trans. N.Z. Inst., vol. xvi., p. 259, pl. 19, fig. 1).

Hab. Lyttelton, C.C.

15. Paranænia dentifera.

Moera dentifera, Haswell (Proc. Linn. Soc., N.S.W., vol. iv., p. 332; pl. 20, fig. 4).

Paranænia dentifera, Chilton (Trans. N.Z. Inst., vol. xvi., p. 260, pl. 21, fig. 2).

Hab. Lyttelton, C.C. (Port Jackson.)

16. Paranænia longimana.

Paranænia longimana, Chilton (Trans. N.Z. Inst., vol. xvi., p. 261, pl. 20, fig. 2).

Hab. Lyttelton, C.C.

17. Iphigenia typica.

Iphigenia typica, Thomson (Trans. N.Z. Inst., vol. xiv., p. 237, pl. 18, fig. 4).

Hab. Dunedin, G.M.T.; Lyttelton, C.C.

Fam. II. Orchestiidæ.

18. Nicea neo-zelanica.

Nicea novæ-zealandiæ, Thomson (Trans. N.Z. Inst., vol. xi., p. 235).

Hab. Along east coast of Otago, G.M.T.

19. Nicea fimbriata.

Nicea fimbriata, Thomson (Trans. N.Z. Inst., vol. xi., p. 236).

Hab. Dunedin, G.M.T.

20. Nicea rubra.

Nicea rubra, Thomson (Trans. N.Z. Inst., vol xi., p. 236).

Hab. Dunedin, G.M.T.; Timaru, Lyttelton, Sumner, C.C.

21. Nicea egregia.

Nicea egregia, Chilton (Trans. N.Z. Inst.).

22. Allorchestes neo-zelanica.

Allorchestes novi-zealandiæ, Dana (U.S. Explor. Exped., p. 894, pl. 61, fig. 1). Bate (Brit. Mus. Cat. Amph., p. 37, pl. 6, fig, 3). Miers (Cat. N.Z. Crust., p. 125).

Hab. Dunedin, Sumner, G.M.T.; Bay of Islands, Dana; Moeraki, T. J. Parker; Lyttelton, C.C.

23. ALLORCHESTES BREVICORNIS.

Allorchestes brevicornis, Dana (U.S. Explor. Exped., p. 893, pl. 60, fig. 8). Bate (Brit. Mus. Cat. Amph., p. 44, pl. 7, fig. 4). Miers (Cat. N.Z. Crust., p. 125).

Hab. Bay of Islands, Dana. [We have not seen this species, G.M.T., C.C.]

24. ALLORCHESTES RECENS.

Allorchestes recens, Thomson (Trans. N.Z. Inst., vol. xvi., p. 235, pl. 13, figs. 2–5).

Hab. Wellington, G.M.T.

25. ORCHESTIA AUCKLANDIÆ.

Orchestia aucklandiæ, Bate (Brit. Mus. Cat Amph., p. 17, pl. 1A, fig. 3). Miers (Cat. N.Z. Crust., p. 121).

Hab. Auckland Island, Stewart Island, G.M.T.; Auckland (Coll. Paris Mus.).

26. ORCHESTIA TELLURIS.

Orchestia telluris, Bate (Brit. Mus. Cat. Amph., p. 20, pl. 3, fig. 6; and pl. 4, fig. 4). Miers (Cat. N.Z. Crust., p. 122).

Hab. Common on sandy shores, from Bay of Islands to Stewart Island, G.M.T.

27. ORCHESTIA CHILENSIS.

Orchestia chilensis, M.-Edw. (Hist. des Crust., t. iii., p. 18). Bate (Brit. Mus. Cat. Amph., p. 30, pl. 1A, fig. 8; and pl. 5, fig. 2). Miers (Cat. N.Z. Crust., p. 123).

Hab. Common on the sea-coast, G.M.T. (Chili.)

28. ORCHESTIA SERRULATA.

Orchestia serrulata, Dana (U.S. Explor. Exped., p. 871, pl. 58, fig. 7). Bate (Brit. Mus. Cat. Amph., p. 31, pl. 5, fig. 4). Miers (Cat. N.Z. Crust., p. 124).

Hab. Bay of Islands, Dana; Stewart Island, G.M.T.

29. ORCHESTIA SYLVICOLA.

Orchestia sylvicola, Dana (U.S. Explor. Exped., p. 874, pl. 59, figs. 2, 3). Bate (Brit. Mus. Cat. Amph., p. 21, pl. 3, fig. 7). Miers (Cat. N.Z. Crust., p. 122). Thomson (Trans. N.Z. Inst., vol. xiii., p. 208).

Orchestia tenuis, Dana (*l.c.*, p. .) Bate, (*l.c.*, p. 29, pl 4, fig. 10).

Orchestia novæ-zealandiæ, Bate (*l.c.*, p. 20, pl. 3, fig. 5).

Hab. Common throughout New Zealand, G.M.T., C.C.

30. TALORCHESTIA TUMIDA.

M.S. species, G. M. Thomson. (N.Z. Journal of Science, vol. ii., p. 577.)

Hab. Purakanui, near Dunedin, G.M.T.

31. TALORCHESTIA QUOYANA.

♂ *Talorchestia quoyana*, Dana (U.S. Expl. Exped., p. 846). Bate (Brit. Mus. Cat. Amph., p. 16, pl. 2, fig. 7). Miers (Cat. N.Z. Crust., p. 120).

♀ *Orchestia (Talitrus) novi-zealandiæ*, Dana (U.S. Expl. Exped., pl. 56, fig. 5).

♀ *Orchestoidea* (?) *novæ-zealandiæ*, Bate (Brit. Mus. Cat. Amph., p. 10, pl. 1, fig. 2).

♀ *Talitrus* (?) *novæ-zealandiæ*, Miers (Cat. N.Z. Crust., p. 119).

Hab. Common on all sandy shores in New Zealand, G.M.T., C.C.

32. TALITRUS BREVICORNIS.

Talitrus brevicornis, M.-Edw. (Hist. d. Crust., vol. iii., p. 15). Dana (U.S. Expl. Exped., pl. 56, fig. 6). Bate (Brit. Mus. Cat. Amph., p. 9, pl. 1A, fig. 6). Miers (Cat. N.Z. Crust., p. 119).

Hab. Bay of Islands, Dana and G.M.T.; Dunedin, G.M.T.

Fam. III. Gammaridæ.

33. GAMMARUS FRAGILIS.

Gammarus fragilis, Chilton (Trans. N.Z. Inst., vol. xiv., p. 179, pl. 9, figs. 11–18).

Hab. Eyreton and Winchester (in wells), C.C.

34. MEGAMŒRA FASCICULATA.

Megamœra fasciculata, Thomson (Ann. and Mag. Nat. Hist. 5, vol. vi., p. 5, pl. 1, fig. 5).

Hab. Dunedin and Sumner, G.M.T.; Timaru and Lyttelton, C.C.

35. MŒRA SUB-CARINATA.

Megamœra sub-carinata, Haswell (Proc. Linn. Soc. N.S.W., vol. iv., p. 335, pl. 21, fig. 4).

Mœra petriei, Thomson (Trans. N.Z. Inst., vol. xiv., p. 236, pl. 18, fig. 3).

Hab. Stewart Island, G.M.T.; Lyttelton, C.C. (Sydney.)

36. MŒRA QUADRIMANA.

Gammarus quadrimanus, Dana (U.S. Expl. Exped., p. 955, pl. 65, fig. 9).

Mœra quadrimana, Bate (Brit. Mus. Cat. Amph., p. 194, pl. 35, fig. 5). Thomson (Trans. N.Z. Inst., vol. xiv., p. 235, pl. 17, fig. 4).

Hab. Stewart Island, G.M.T. (Fiji.)

37. MŒRA INCERTA.

Mœra incerta, Chilton (Trans. N.Z. Inst., vol. xv., p. 83, pl. 3, fig. 3).

Hab. Lyttelton, C.C.

38. MŒRA SPINOSA.

Mœra spinosa, Haswell (Proc. Linn. Soc. N.S.W., vol. iv., p. 268, pl. 10, fig. 5). Chilton (Trans. N.Z. Inst., vol. xv., p. 81).

Hab. Auckland, C.C. (Tasmania.)

39. MELITA TENUICORNIS.

Melita tenuicornis, Dana (U.S. Expl. Exped., p. 963). Thomson (Trans. N.Z. Inst., vol. xi., p. 241).

Mœra tenuicornis, Bate (Brit. Mus. Cat. Amph., p. 195, pl. 35, fig. 6).

Paramœra tenuicornis, Miers (Cat. N.Z. Crust., p. 127).

Hab. East Coast of Otago, G.M.T.; Timaru, Lyttelton, C.C.; Bay of Islands, Dana.

40. POLYCHERIA OBTUSA.

Polycheria obtusa, Thomson (Trans. N.Z. Inst., vol. xiv., p. 233, pl. 17, fig. 3).

Hab. Stewart Island, G.M.T.; Lyttelton, C.C.

41. HARMONIA CRASSIPES.

Harmonia crassipes, Haswell (Proc. Linn. Soc. N.S.W., vol. iv., p. 330, pl. 19, fig. 3). Chilton (Trans. N.Z. Inst., vol. xv., p. 82).

Hab. Lyttelton, Timaru, C.C. (Sydney.)

42. CRANGONYX COMPACTUS.

Crangonyx compactus, Chilton (Trans. N.Z. Inst., vol. xiv., p. 177, pl. 10, figs. 13–19).

Hab. Eyreton (in wells), C.C.

43. AORA TYPICA.

♂ *Aora typica*, Kröyer (Tidskr., ser. 2, vol. i., p. 328). Bate (Brit. Mus. Cat. Amph., p. 161, pl. 29, fig. 8).

♀ *Microdeutopus maculatus*, Thomson (Ann. and Mag. Nat. Hist. 5, vol. iv., p. 331, pl. 16, figs 5–8).

♂ *Microdeutopus mortoni*, Haswell (Proc. Linn. Soc. N.S.W., vol. iv., p. 339, pl. 22, fig. 2).

♀ *Microdeutopus tenuipes*, Haswell (*l.c.*, p. 339, pl. 22, fig. 1).

♂ *Microdeutopus maculatus*, Chilton (Trans. N.Z. Inst., vol. xiv., p. 73).

Hab. Dunedin, Stewart Island, G.M.T.; Lyttelton, Sumner, Timaru, Auckland, C.C. (Sydney, Valparaiso.)

44. Leucothoë trailii.

Leucothoë trailii, Thomson (Trans. N.Z. Inst., vol. xiv., p. 234, pl. 18, fig. 1).

Hab. Stewart Island, G.M.T.; Lyttelton, C.C.

45. Seba typica.

Teraticum typicum, Chilton (Trans. N.Z. Inst., vol. xvi., p. 257, pl. 18, fig. 1).

Seba typica, Chilton (N.Z. Journ. Sc., vol. ii, p. 320).

Hab. Lyttelton, C.C.

46. Eusirus cuspidatus, var. antarcticus.

Eusirus cuspidatus, Kröyer (Tidskr. 2, vol. i., p. 501, pl. 7, fig. 1). Bate (Brit. Mus. Cat. Amph., p. 154, pl. 28, figs. 6, 7). Var. *antarcticus*, Thomson (Ann. and Mag. Nat. Hist. 5, vol. vi, p. 4).

Hab. Dunedin, G.M.T. (Greenland.)

47. Amphithonotus levis.

Amphithontus lævis, Thomson (Ann. and Mag. Nat. Hist. 5, vol. iv., p. 330, pl. 16, figs 1 to 4).

Hab. Dunedin, G.M.T.; Timaru, Lyttelton, C.C.

48. Calliopius didactylus.

Calliope didactyla, Thomson (Trans. N.Z. Inst., vol. xi., p. 240).

Hab. East Coast of Otago, G.M.T.

49. Calliopius fluviatilis.

Calliope fluviatilis, Thomson (Trans. N.Z. Inst., vol. xi., p. 240).

Hab. Common in streams, ditches, etc., in Otago, G.M.T.; very common in streams, etc., North Canterbury, C.C.

50. Calliopius subterraneus.

Calliopius subterraneus, Chilton (Trans. N.Z. Inst., vol. xiv., p. 177, pl. 9, figs. 1–10).

Hab. Winchester and Eyreton (in wells), C.C.

51. Pherusa neo-zelanica.

Pherusa novæ-zealandiæ, Thomson (Trans. N.Z. Inst., vol. xi., p. 239).

Hab. Dunedin, G.M.T.

52. Pherusa cœrulea.

Ms. species, G. M. Thomson (N.Z. Journ. of Science, vol. ii., p. 576).

Hab. Stream on the Old Man (Obelisk) Range, Otago, 3,000ft. elevation, G.M.T.

53. Atylus danai.

Atylus danai, Thomson (Trans. N.Z. Inst., vol. xi., p. 238).

Hab. East coast of Otago, common, G.M.T.; Timaru, Lyttelton, Sumner, C.C.

54. Dexamine pacifica.

Dexamine pacifica, Thomson (Trans. N.Z. Inst., vol. xi., p. 238).

Hab. Stewart Island, Dunedin, G.M.T.; Lyttelton, C.C.

55. Amphilochus squamosus.

Amphilochus squamosus, Thomson (Ann. and Mag. Nat. Hist., 5, vol. vi., p. 4, pl. 1, fig. 4).

Hab. Dunedin, G.M.T.

56. Œdicerus neo-zelanicus.

Œdicerus novæ-zealandiæ, Dana (U.S. Expl. Exped., p. 934, pl. 63, fig. 7). Bate (Brit. Mus. Cat. Amph., p. 104, pl. 17, fig. 1). Miers (Cat. N.Z. Crust., p. 126).

Hab. Bay of Islands, Dana; I do not know this species, G.M.T.; Lyttelton (identification doubtful), C.C.

57. Phoxus batei.

Phoxus batei, Haswell (Proc. Linn. Soc. N.S.W., vol. iv., p. 259, pl. 9, fig. 3). Thomson (Trans. N.Z. Inst., vol. xiv., p. 232, pl. 18, fig, 2).

Hab. Stewart Island, G.M.T. (Sydney.)

58. Bircenna fulva.

Bircenna fulva, Chilton (Trans. N.Z. Inst., vol. xvi., p. 264, pl. 21, fig. 1).

Hab. Lyttelton, C.C.

59. Anonyx exiguus.

Anonyx exiguus, Stimpson (Mar. Invert. Gr. Manan, p. 51). Bate (Brit. Mus. Cat. Amph., p. 75, pl. 12, fig. 3). Thomson (Trans. N.Z. Inst., vol. xiv., p. 232, pl. 18, fig. 2).

Hab. Stewart Island, G.M.T. (E. coast of N. America.)

60. Anonyx corpulentus.

Anonyx corpulentus, Thomson (Trans. N.Z. Inst., vol. xiv., p. 231, pl. 17, fig. 1).

Hab. Stewart Island, G.M.T.

61–63. Lysianassa sp.

Lysianassa kröyeri, Bate (Brit. Mus. Cat. Amph., p. 65, pl. 10, fig. 4). Thomson (Trans. N.Z. Inst., vol. xi., p. 237).

The above identification is extremely doubtful; the species referred to it has been found at Dunedin Harbour and Stewart Island, G.M.T. I have at least three species of the genus from

Lyttelton and elsewhere, none of them referable to *L. kröyeri* without considerable doubt, C.C. [Descriptions of these are not published pending the publication of the *Challenger* report on the *Amphipoda.*]

[In the "Zool. Coll. of H.M.S. *Alert*," p. 312, Mr. Miers refers to this genus and species as *Ephippiphora kröyeri* (White), the original designation. Meanwhile the limits of the genus and the characters of the species require complete revision.]

64. PLEUSTES PANOPLUS.

Pleustes panoplus, Kröyer (Grön. Amf., p. 42). Bate (Brit. Mus. Cat. Amph., p. 63, pl. 9, fig. 9). Kirk (Trans. N.Z. Inst., vol. xi., p. 402).

Hab. Wellington, T. W. Kirk. (Greenland, North Atlantic.)

65. PANOPLŒA SPINOSA.

Panoplœa spinosa, Thomson (Ann. and Mag. Nat. Hist., 5, vol. vi., p. 3, pl. 1, fig. 2).

Hab. Dunedin, G.M.T.; Lyttelton, C.C.

66. PANOPLŒA DEBILIS.

Panoplœa debilis, Thomson (Ann. and Mag. Nat. Hist., 5, vol. p. 3, pl. 1, fig. 3).

Hab. Dunedin, G.M.T.; Lyttelton, C.C.

67. PANOPLŒA TRANSLUCENS.

Panoplœa translucens, Chilton (Trans. N.Z. Inst., vol. xvi., p. 263, pl. 21, fig. 3).

Hab. Lyttelton, C.C.

68. CYPROIDIA (?) CRASSA.

Cyproidia (?) *crassa*, Chilton (Trans. N.Z. Inst., vol. xv., p. 80, pl. 3, fig, 1).

Hab. Lyttelton, C.C. [This species is only placed here provisionally.]

69. PROBOLIUM MIERSII.

Montagua miersii, Haswell (Proc. Linn. Soc. N.S.W., vol. iv., p. 323, pl. 24, fig. 4).

Montaguana miersii, Chilton (Trans. N.Z. Inst., vol. xv., p. 79).

Hab. Timaru, Lyttelton, C.C. (Port Jackson.)

Tribe III. Hyperina.

Fam. I. Phronimidæ.

70. PHRONIMA NEO-ZELANICA.

Phronima novæ-zealandiæ, Powell (Trans. N.Z. Inst., vol. vii., p. 294, pl. 21, fig. 1). Miers (Cat. N.Z. Crust., p. 129).

Hab. Common on East Coast of Otago, G.M.T.; Sumner, Powell; West Coast, Haast; Wellington, Kirk.

71. THEMISTO ANTARCTICA.

Themisto antarctica, Dana (U.S. Expl. Exped., p. 1005, pl. 69, fig. 1). Bate (Brit. Mus. Cat. Amph., p. 312, pl. 50, fig. 8). Thomson (Trans. N.Z. Inst., vol. xi., p. 243).

Hab. East Coast of Otago, G.M.T. (Antarctic Ocean.)

Fam. II. Platyscelidæ.

72. PLATYSCELUS INTERMEDIUS.

Platyscelus intermedius, Thomson (Trans. N.Z. Inst., vol. xi., p. 244).

Hab. East Coast of Otago, G.M.T.

73. OXYCEPHALUS EDWARDSII.

Oxycephalus edwardsii, Thomson (Trans. N.Z. Inst., vol. xvi., p. 238, pl. 12, figs. 14 to 21, and pl. 13, fig. 1).

Hab. East Coast of Otago, G.M.T.

74. PHREATOICUS TYPICUS.

Phreatoicus typicus, Chilton (Trans. N.Z. Inst., vol. xv., p. 89, pl. 4).

Hab. Winchester and Eyreton (in wells), C.C.

[The systematic position of this singular crustacean is doubtful. In general appearance, I was inclined to place it among the *Amphipoda*, but from the fact of the first five pairs of *pleopoda* acting as branchial organs, and from the absence of any such organs attached to the *pereion*, Mr. Chilton places it among the *Isopoda*.—G.M.T.]

Sub-order II.—Isopoda.

Tribe I. Anisopoda.

Fam. 1. Tanaidæ.

75. TANAIS NEO-ZELANICA.

Tanais novæ-zealandiæ, G. M. Thomson (Ann. and Mag. Nat. Hist., 5, vol. iv., p. 417, pl. 19; Trans. N.Z. Inst., vol. xiii., p. 207, pl. 7).

Hab. Dunedin Harbour, G.M.T.; Lyttelton, C.C.

76. PARATANAIS TENUIS.

Paratanais tenuis, G. M. Thomson (Ann. and Mag. Nat. Hist., 5, vol. vi., p. 2, pl. 1; Trans. N.Z. Inst., vol. xiii., p. 207).

Hab. Dunedin Harbour, G.M.T.; Lyttelton, C.C.

77. APSEUDES TIMARUVIA.

Apseudes timaruvia, Chilton (Trans. N.Z. Inst., vol. xv., p. 146, pl. 18).

Hab. Timaru, C.C.

78. Apseudes latus.

Apseudes latus, Chilton (Trans. N.Z. Inst., vol. xvi., p. 249, pl. 17).

Hab. Lyttelton, C.C.

79. Anthura flagellata.

Anthura flagellata, Chilton (Trans. N.Z. Inst., vol. xiv., p. 172, pl. 8).

Hab. Lyttelton, C.C.

80. Anthura affinis.

Anthura affinis, Chilton (Trans. N.Z. Inst., vol. xv., p. 72, pl. 1).

Hab. Lyttelton, C.C.

81. Paranthura costana.

Anthura gracilis, Milne-Edwards (Hist. des Crust., vol. iii., p. 136, pl. 31).

Paranthura costana, Bate and Westwood (Brit. Sessile-eyed Crust., vol. ii., p. 165). Thomson (Trans. N.Z. Inst., vol. xiv., p. 230).

Hab. Mouth of the Taieri River, G.M.T. (English Channel, Mediterranean.)

82. Cruregens fontanus.

Cruregens fontanus, Chilton (Trans. N.Z. Inst., vol. xiv., p. 175, pl. 10).

Hab. Eyreton and Winchester, Canterbury, in wells, C.C.

Tribe II. Euispoda.

Fam. I. Cymothoidæ.

83. Dynamena huttoni.

Dynamena huttoni, G. M. Thomson (Trans. N.Z. Inst., vol. xi., p. 234).

Hab. Dunedin, G.M.T.; Timaru, Lyttelton Harbour, C.C.

84. Cymodocea cordiforaminalis.

Cymodocea cordiforaminalis, Chilton (Trans. N.Z. Inst., vol. xiv., p. 188, pl. 22).

Hab. Lyttelton, C.C.

85. Cymodocea granulata.

Cymodocea granulata, Miers (Ann. and Mag. Nat. Hist., 4, vol. 17, p. 229; Cat. N.Z. Crust., p. 114, pl. 3, fig. 5).

Hab. New Zealand, Miers; Flinders Island and Tasmania. [We do not know this.—G.M.T., C.C.]

86. CYMODOCEA CONVEXA.

Cymodocea convexa, Miers (Ann. and Mag. Nat. Hist. 4, vol. xvii, p. 229 ; Cat. N.Z. Crust., p. 114, pl. 3, fig. 6).

Hab. New Zealand, Miers. [We do not know this.—G.M.T., C.C.]

87. NÆSA CANALICULATA.

Nesea canaliculata, Thomson (Trans. N.Z. Inst., vol xi., p. 234).

Hab. Dunedin, G.M.T. ; Lyttelton, C.C. [Mr. Miers ("Zool. Coll., H.M.S. *Alert*," p. 309) thinks this belongs to the genus *Cilicæa* of Leach. I cannot set this doubt at rest, as the type appears to have been lost.—G.M.T.]

88. AMPHOROIDEA FALCIFER.

Amphoroidea falcifer, Hutton, M.S. Cat. Thomson (Trans. N.Z. Inst., vol xi., p. 233).

Hab. Dunedin and Stewart Island, G.M.T. ; Lyttelton, C.C. (Perhaps this is *A. typica.*—M.-Edwards.)

89. CERATOTHOA IMBRICATA.

Ceratothoa banksii, Miers (Cat. N.Z. Crust., p. 105).

Ceratothoa trigonocephela, Heller (Reise der *Novara*, Crust., p. 148). Thomson (Trans. N.Z. Inst., vol. xi., p. 233).

Ceratothoa imbricata, Miers (Zool. Col. H.M.S. *Alert*, p. 300, where the full synonymy of the species is to be found).

Hab. New Zealand, Miers ; Dunedin, G.M.T. (Australia, India, China.)

90. CERATOTHOA LINEATA.

Ceratothoa lineata, Miers (Ann. and Mag. Nat. Hist. 4, vol. xvii., p. 227 ; Cat. N.Z. Crust., p. 105).

Hab. New Zealand, Miers. [We do not know this species, G.M.T., C.C.]

91. ÆGA NEO-ZELANICA.

Æga novæ-zealandiæ, Dana (U.S. Explor. Exped., p. 767, pl. 51). Miers (Cat. N.Z. Crust., p. 108).

Hab. Bay ot Islands, Dana ; Dunedin and Stewart Island, G.M.T. ; Lyttelton Harbour, C.C. ; Moeraki, T. J. Parker.

92. PSEUDÆGA PUNCTATA.

Pseudæga punctata, G. M. Thomson (Trans. N.Z. Inst., vol. xvi., p. 234, pl. 12).

Hab. Dunedin, G.M.T.

93. Lironeca neo-zelanica.

Lironeca novæ-zealandiæ, Miers (Ann and Mag. of Nat. Hist. 4, vol. xvii., p. 227; Cat. N.Z. Crust., p. 106, pl. 3, fig. 2).

Hab. New Zealand, Miers; Dunedin, G.M.T.; Lyttelton Harbour, C.C.

94. Nerocila macleayii.

Cilonera macleayii, Leach [?] (White in Dieffenb. Voy. N.Z., vol ii., p. 268).

Nerocila imbricata (List Crust. Brit. Mus., p. 108). Miers (Cat. N.Z. Crust., p. 107).

Hab. New Zealand, Fabr. [We do not know this species, G.M.T., C.C.]

95. Cirolana rossii.

Cirolana rossii (List Crust. Brit. Mus., p. 106). Miers (Ann. and Mag. Nat. Hist. 4, vol. xvii., p. 228; Cat. N.Z. Crust., p. 109, pl. 3, fig. 3).

Hab. Auckland Islands, Miers; G.M.T.; Lyttelton Harbour, C.C.

96. Serolis paradoxa.

Serolis paradoxa, And. and M.-Edw. (Archiv. Mus. Hist. Nat., vol. ii., p. 28). Miers (Cat. N.Z. Crust., p. 116, which see for synonymy). Beddard (N.Z. Journ. Sc., vol. ii., p. 390).

Hab. New Zealand ? (Coll. Brit. Mus.). (Patagonia.)

97. Serolis schythei.

Serolis schythei, Lüthen (Naturh. Foren. bidensk, p. 98). Beddard (N.Z. Journ. Sc., vol. ii., p. 390).

Hab. New Zealand ? (Brit. Mus. Coll.) (Patagonia).

98. Serolis bromleyana.

Serolis bromleyana, v. Willemöes-Suhm (Proc. Roy. Soc., vol. xxiv., p. 585). Beddard (N.Z. Journ. Sc., vol. ii., p. 390).

Hab. East of New Zealand; 900 and 1,100 fathoms, Beddard.

99. Serolis latifrons.

Serolis latifrons (List Crust. Brit. Mus., p. 186). Miers (Ann. Mag. Nat. Hist., 4, vol. ., p. 74; Cat. N.Z. Crust., p. 117, pl. 3, fig. 7).

Hab. Auckland Islands (Coll. Brit. Mus.). [We do not know any of the above four species.—G.M.T., C.C.]

100. Scutuloidea maculata.

Scutuloidea maculata, Chilton (Trans. N.Z. Inst., vol. xv., p. 70, pl. 1).

Hab. Lyttelton, Timaru, C.C.

Fam. II. Sphæromidæ.

101. SPHÆROMA GIGAS.

Sphæroma gigas, Leach (Dict. Sci. Nat., vol. xii., p. 346). M.-Edw. (Hist. Nat. Crust., vol. iii., p. 205). Miers (Cat. N.Z. Crust., p. 110).

Hab. Common round the coasts of New Zealand, and at the Auckland Islands, G.M.T., C.C. (Falkland Islands, and Cape Horn.)

102. SPHÆROMA VERRUCAUDA.

Sphæroma verrucauda (List Crust. Brit. Mus., p. 102). Dana (U.S. Explor. Exped., Crust., part ii., p. 779, pl. 53). Miers (Cat. N.Z. Crust., p. 111).

Hab. New Zealand (Coll. Brit. Mus.); Bay of Islands, Dana. (Australia.) [I do not know this species.—G.M.T.]

103. SPHÆROMA OBTUSA.

Sphæroma obtusa, Dana (U.S. Explor. Exped. Crust., part ii., p. 779, pl. 53). Miers (Cat. N.Z. Crust., p. 112).

Hab. Bay of Islands, Dana; G.M.T.; Lyttelton (?), C.C.; Campbell Island, G.M.T.

104. ISOCLADUS ARMATUS.

Sphæroma armata, M.-Edw. (Hist. Nat. Crust., vol. iii., p. 210). White (Dieffenb. New Zeal., vol. ii., p. 268). Dana (U.S. Explor. Exped., Crust., vol. ii., p. 780, pl. 52).

Isocladus armatus, Miers (Cat. N.Z. Crust., p. 112).

Hab. New Zealand (Coll. Mus. Paris); Bay of Islands, Dana; G.M.T.

105. ISOCLADUS SPINIGER.

Sphæroma spinigera, Dana (U.S. Explor. Exped., Crust., vol. ii., p. 780, pl. 52).

Isocladus spiniger, Miers (Cat. N.Z. Crust., p. 113, pl. 3).

Hab. New Zealand (Coll. Brit. Mus.); Bay of Islands, Dana; Lyttelton, C.C. [I do not think I know this form, G.M.T.]

Fam. III. Idoteidæ.

106. IDOTEA MARINA.

Oniscus marinus, Linn. (Fauna Suecica, p. 500), etc.

Idotea marina, Miers (Journ. Linn. Soc., vol. xvi., p. 25; which see for complete synonomy).

Hab. Coast of New Zealand (M. Petit, in Paris Mus. Coll.).

107. IDOTEA METALLICA.

Idotea metallica, Bosc. (Hist. Nat. Crust., vol. ii., p. 179, pl. 15). Miers (Journ. Linn. Soc., vol. xvi., p. 35).

Idotea argentea, Dana (U.S. Explor. Exped. Crust., vol. ii., p. 698, pl. 46). Miers (Cat. N.Z. Crust., p. 92).

Hab. New Zealand (?), Dana.

108. Idotea margaritacea.

Idotea margaritacea, Dana (U.S. Explor. Exped. Crust., vol. ii., p. 700, pl. 46). Miers (Cat. N.Z. Crust., p. 92 ; Journ. Linn. Soc., vol. xvi., p. 38).

Hab. Between Australia and New Zealand, Dana.

[We do not know the preceding three species, G.M.T., C.C.]

109. Idotea lacustris.

Idotea lacustris, G. M. Thomson (Trans. N.Z. Inst., vol. xi., p. 250). Miers (Journ. Linn. Soc., vol. xvi., p. 39).

Hab. Tomahawk lagoon, near Dunedin, Hutton; G.M.T. (Port Henry, Straits of Magellan ?)

110. Idotea ungulata.

Idotea ungulata, Lam. (Hist. Anim. sans Vert., v., p. 160). Miers (Journ. Linn. Soc., vol. xvi., p. 52).

Idotea affinis, M.-Edw. (Hist. Nat. Crust., vol. iii., p. 133). Miers (Cat. N.Z. Crust., p. 93). Thomson (Trans. N.Z. Inst., vol. xi., p. 232).

Hab. Common round the coasts of New Zealand, G.M.T., C.C.

111. Idotea elongata.

Idotea elongata (List Crust. Brit. Mus., p. 95). Miers (Ann. Mag. Nat. Hist., 4, vol. xvii., p. 225 ; Cat. N.Z. Crust., p. 93, pl. 2 ; Journ. Linn. Soc., vol. xvi., p. 54).

Hab. Auckland Islands (Coll. Brit. Mus.) ; Auckland (Coll. Paris Mus.) ; Lyttelton, C.C. ; Akaroa, R. M. Laing.

112. Idotea festiva.

Idotea festiva, Chilton (N.Z. Journ. of Science, vol. ii., p. 320 ; Ann. Mag. Nat. Hist., 5, vol. , p. 123, pl. 5A., figs. 1 to 3.

Hab. Sumner, near Christchurch, C.C.

113. Edotia dilatata.

Edotia dilatata, G. M. Thomson (Trans. N.Z. Inst., vol. xvi., p. 235, pl. 12).

Hab. Auckland, T. F. Cheeseman.

114. Cleantis tubicola.

Cleantis tubicola, Thomson (N.Z. Journ. of Science, vol. ii., p.).

Hab. Auckland, R. Gillies.

115. Arcturus tuberculatus.

Arcturus tuberculatus, Thomson (Ann. Mag. Nat. Hist., 5, vol. iv., p. 416, pl. 19 ; Trans. N.Z. Inst., vol. xiii., p. 206, pl. 7).

Hab. Dunedin Harbour, G.M.T. ; Lyttelton Harbour, C.C.

Fam. IV. Aseilidæ.

116. JÆRA NEO-ZELANICA.

Jæra novæ-zealandiæ, Chilton (Trans. N.Z. Inst., vol. xv., p. 189).

Hab. Lyttelton, C.C.

117. LIMNORIA SEGNIS.

Limnoria segnis, Chilton (Trans. N.Z. Inst., vol. xv., p. 76, pl. 2).

Hab. Lyttelton, C.C.

118. JANIRA LONGICAUDA.

Janira longicauda, Chilton (Trans. N.Z. Inst., vol. xvi., p. 250, pl. 18).

Hab. Lyttelton, C.C.

119. STENETRIUM FRACTUM.

Stenetrium fractum, Chilton (Trans. N.Z. Inst., vol. xvi., p. 251, pl. 18).

Hab. Lyttelton, C.C.

Fam. V. Oniscidæ.

120. LIGIA NEO-ZELANICA.

Ligia novæ-zealandiæ, Dana (U.S.Explor. Exped., Crust., vol. ii., p. 739, pl. 49). Miers (Cat. N.Z. Crust., p. 103).

Hab. Bay of Islands, Dana. [I do not know this species, G.M.T.]

121. LIGIA QUADRATA.

Ligia quadrata, Hutton (M.S. Cat. N.Z. Crust.). Thomson (Trans. N.Z. Inst., vol. xi., p. 232).

Hab. Bay of Islands, Waiwera, Dunedin, Stewart Island, G.M.T.; Lyttelton, Sumner, C.C.

122. PHILYGRIA ROSEA.

Itea rosea, Koch (Contin. Panzer Deutsch. Ins., 162, 16; Deutsch. Crust., 22, 16).

Philougria rosea, Kinahan (Nat. Hist. Rev., vol. v., p. 197, pl. 23). Bate and Westwood (Brit. Sess.-eyed Crust., vol. ii., p. 460). Chilton (Trans. N.Z. Inst., vol. xv., p. 73).

Hab. Canterbury generally, and Lake Wakatipu, C.C.; Nelson (in a cave), J. C. Gully. (Britain, Germany.)

123. PHILYGRIA THOMSONII.

Philougria thomsoni, Chilton (N.Z. Jour. Sci., vol. ii., p.).

Hab. Spar Bush, Southland, C.C.

124. Oniscus punctatus.

Oniscus punctatus, Thomson (Trans. N.Z. Inst., vol. xi., p. 232).

Hab. Common from Auckland to Stewart Island, G.M.T., C.C.

125. Oniscus pubescens.

Oniscus pubescens, Dana (U.S. Explor. Exped. Crust., vol. ii., p. 730, pl. 48). Miers (Cat. N.Z. Crust., p. 99).

Hab. Whaikare River, Dana. [I do not know this species.—G.M.T.]

126. Porcellio graniger.

Porcellio graniger (List Crust. Brit. Mus., p. 99). Miers (Ann. Mag. Nat. Hist., 4, vol. xvii., p. 226; Cat. N.Z. Crust., p. 99).

Hab. Common everywhere in New Zealand, G.M.T., C.C.

127. Porcellio neo-zelanicus.

Porcellio zealandicus (List Crust. Brit. Mus., p. 99). Miers (Ann. Mag. Nat. Hist., 4, vol. xvii., p. 225; Cat. N.Z. Crust., p. 100, pl. 2).

Hab. New Zealand (Coll. Brit. Mus.). [We do not know this species.—G.M.T., C.C.]

128. Scyphax ornatus.

Scyphax ornatus, Dana (U.S. Explor. Exped., Crust., vol. ii., p. 734, pl. 48). Miers (Cat. N.Z. Crust., p. 101).

Hab. Bay of Islands, Dana.

129. Scyphax intermedius.

Scyphax intermedius, Miers (Ann. Mag. Nat. Hist., 4, vol. xvii., p. 227; Cat. N.Z. Crust., p. 102, pl. 2).

Hab. New Zealand (Coll. Brit. Mus.). [We do not know the two foregoing species.—G.M.T., C.C.]

130. Actæcia euchroa.

Actæcia euchroa, Dana (U.S. Explor. Exped., Crust., vol. ii., p. 734 ?). Miers (Cat. N.Z. Crust., p. 102). Thomson (Trans. N.Z. Inst., vol. xi., p. 249).

Hab. Bay of Islands, Dana, G.M.T.; Dunedin, G.M.T.

131. Actæcia aucklandiæ.

Actæcia aucklandiæ, Thomson (Trans. N.Z. Inst., vol. xi., p. 249).

Hab. Auckland Islands, Jennings.

132. Cubaris rugulosus.

Cubaris rugulosus, Miers (Ann. and Mag. Nat. Hist., 4, vol. xvii., p. 225; Cat. N.Z. Crust, p. 96, pl. 2). Chilton (Trans. N.Z. Inst., vol. xv., p. 73).

Hab. New Zealand (Coll. Brit. Mus.); Dunedin, G.M.T.; Canterbury and Southland, C.C.

133. SPHERILLO MONOLINUS.

Spherillo monolinus, Dana (U.S. Explor. Exped., Crust., vol. ii., p. 719, pl. 47). Miers (Cat. N.Z. Crust., p. 97).

Hab. Auckland, Heller; Waikare River (Coll. Dr. C. Pickering, Dana). [I do not know this species.—G.M.T.]

134. SPHERILLO SPINOSUS.

Spherillo spinosus, Dana (U.S. Explor. Exped. Crust., vol. ii., p. 723, pl. 47). Miers (Cat. N.Z. Crust., p. 97).

Hab. Near Bay of Islands (Coll. Dr. C. Pickering, Dana); Dunedin (?), G.M.T.

135. SPHERILLO DANÆ.

Spherillo danæ, Heller (Voy. *Novara*, Crust., p. 134, pl. 12). Miers (Cat. N.Z. Crust., p. 97).

Hab. Auckland, Heller. [I do not know this species.—G.M.T.]

136. ARMADILLO SPECIOSUS.

Armadillo speciosus, Dana (U.S. Explor. Exped., Crust., vol. ii., p. 718, pl. 47). Miers (Cat. N.Z. Crust., p. 95).

Hab. Bay of Islands, Dana; Wellington, Hutton; Nelson, J. C. Gully.

137. ARMADILLO INCONSPICUUS.

Armadillo inconspicuus, Miers (Ann. and Mag. Nat. Hist., 4, vol. xvii., p. 225; Cat. N.Z. Crust., p. 95, pl. 2).

Hab. New Zealand (Coll. Brit. Mus). [I do not know this species.—G.M.T.]

Gen. et sp. incertæ sedis.

138. PLAKARTHRIUM TYPICUM.

Plakarthrium typicum, Chilton (Trans. N.Z. Inst., vol. xv., p. 74, pl. 1).

Hab. Lyttelton, C.C.

ART. XXXIV.—*A New Species of* Philygria.*

By CHAS. CHILTON, M.A.

[*Read before the Philosophical Society of Canterbury, 26th November, 1885.*]

Plate V.

PHILYGRIA THOMSONI, sp. nov. Plate V., figs. 1 to 6.

BODY, fairly convex; length, about twice the greatest breadth; first segment of thorax produced anteriorly on each side into rounded lobes, so as to enclose about half of the head, which is

* From a remark in the "Zoological Record" for 1877, Crust., p. 24, it appears that *Philygria* is a more correct spelling of the word than *Philougria*.

small and transversely elliptical, and is produced below and in front of the eyes into small rounded projections. Last six segments of thorax of about equal lengths, and shorter than the first; last three with the postero-lateral angles acute, produced. Abdomen much narrower than the thorax, and narrowing considerably posteriorly; lateral margins nearly straight; last segment subtriangular, with apex truncate; posterior margin, and the posterior portions of the lateral margins, perfectly straight. Surface smooth and shining, apparently with very short setæ at intervals. Colour, mostly black, or very dark brown, with markings of light yellow or white.

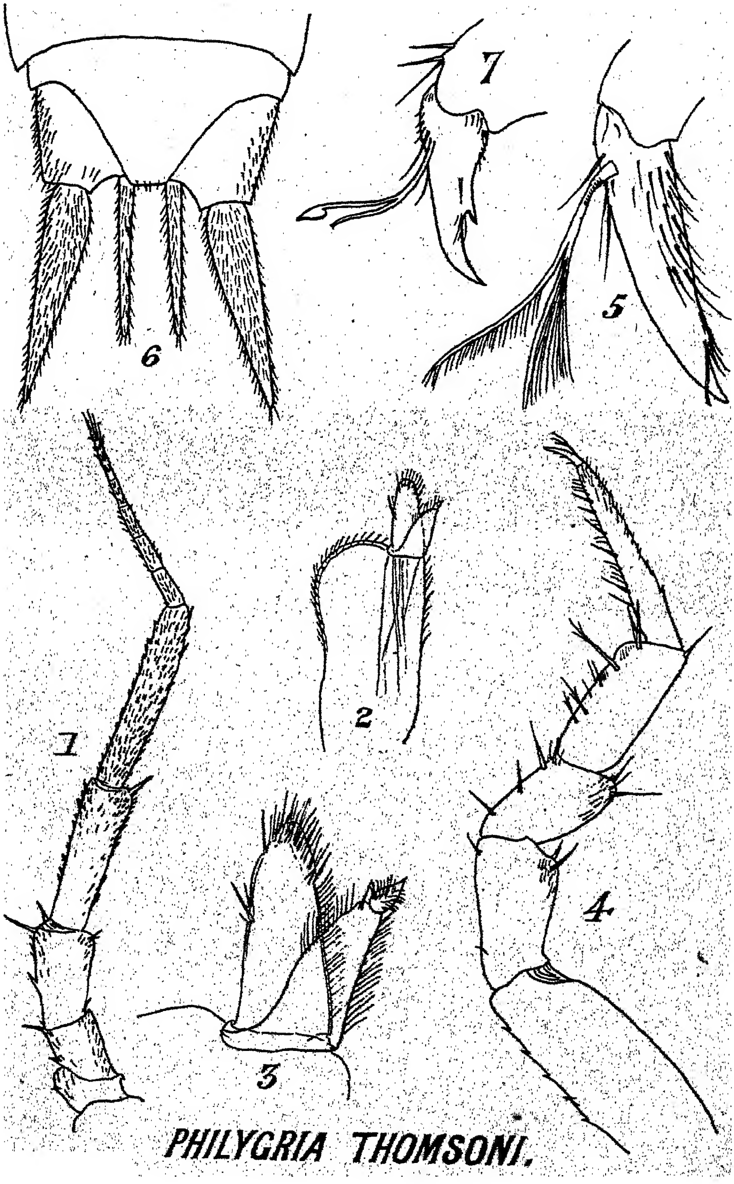
Inner antenna small, but able to be seen in dorsal view. Outer antenna, with the first three joints increasing in length; third, as long as the first and second together; fourth, half as long again as the third, and about three-fourths as long as the fifth. Third stouter than the fourth, which is stouter than the fifth. Flagellum as long as the fifth joint, and tapering gradually; clearly divided into five joints, and the last, which is longer than any of the others, bears indistinct marks as if divided into two, the extremity bearing a pencil of straight setæ. Whole antenna, thickly covered with very fine setæ, and having larger setæ at the distal ends of the second, third, and fourth joints. Thoracic legs, increasing considerably in length posteriorly, bearing many long, stiff setæ, particularly on the carpus, near the distal end of which the longest is situated. Dactylos bearing a peculiar seta longer than the dactylos itself; it is stout at base, and soon splits up into two branches of about equal size; the branch remote from the dactylos giving off numerous sub-branches on the side near the dactylos; the other branch splitting into several branches, which still further subdivide towards the end. Posterior pleopoda rather large, two-thirds as long as the abdomen; inner ramus articulated to the inner margin of the peduncle anteriorly to the outer ramus, slender, and about three-fourths as long as outer ramus, which narrows rapidly towards the extremity; both bear a few setæ at the end, and are thickly covered with very short setæ.

Length: ·3 inch.

Hab.—Spar bush, Southland.

I have named this species after Mr. G. M. Thomson, from whom I have received much kind assistance.

In general appearance, and in the form of the outer antenna, it differs considerably from the species common in many parts of the South Island, which I have previously identified with *Philygria rosea*, and it is much larger than the ordinary specimens of this species; though I have one specimen of *P. rosea* from Kinloch, Lake Wakatipu, quite as large as any of my specimens of *P. thomsoni*. In some details, however, I find the two are strikingly alike. This is particularly the case with the



PHILYGRIA THOMSONI.

maxillipedes and the peculiar setæ on the dactylos of each of the thoracic legs. In *P. thomsoni*, in the maxilipedes (see fig. 2), there is a large basal joint, which bears at its extremity two small, but well-marked branches. The inner branch consists of two joints; the first much the larger of the two, narrowing distally, and having both margins fringed with fine straight setæ, the outer margin being slightly crenate towards the distal end. The second joint is conical in shape, and bears many curved setæ projecting radically around the joint. The outer branch is slightly longer than the inner, and consists of a single joint, which narrows distally and is rounded at the end, the inner margin fringed with fine straight setæ, and the rounded end thickly supplied with stouter stiff setæ which vary considerably in thickness, one of the stoutest being situated on the outer margin, slightly removed from the others; and more proximally at the centre of the outer margin is another one equally stout, with one or two more delicate setæ alongside it. The description here given would apply almost equally well to the maxillipede of *P. rosea*, but, as the specimens of that species are smaller, the various details are not so distinctly marked.

The form of the pecular seta arising from the dactylos of each of the thoracic legs, will be readily understood from the description already given, and from the drawing of it in fig. 5. The one found in *P. rosea* is practically identical in form. In *P. marina*, Coogee Bay, Sydney, there is a seta found in the same position, but it is of quite a different form; I give a drawing (fig. 7) for the sake of comparison. The other setæ on the legs of *P. thomsoni* generally show a transverse division in the centre, and are split towards the end; but the parts lie close together, and are often difficult to see.

DESCRIPTION OF PLATE V.

PHILYGRIA THOMSONI.—*Figs.* 1 *to* 6.

Fig. 1. Outer antenna × 30.
Fig. 2. Maxillipede × 39.
Fig. 3. End of same × 120.
Fig. 4. Seventh thoracic leg × 30.
Fig. 5. Dactylos of same × 233.
Fig. 6. Extremity of abdomen × 30.

PHILYGRIA MARINA.—*Fig.* 7.

Fig. 7. Dactylos of thoracic leg × 233.

Art. XXXV.—*Description of New Zealand* Micro-Lepidoptera.

By E. Meyrick, B.A.

[*Read before the Canterbury Philosophical Institute, 1st October,* 1885.]

VIII. TINEINA (Part).

The New Zealand species of four families—the *Gelechiadæ*, *Depressariadæ*, *Plutellidæ*, and *Micropterygidæ*—are here described, together with an additional species of *Gracilariadæ*. All these are scantily represented, and, though they will doubtless be materially increased, are never likely to occupy any conspicuous place in the fauna; but the *Micropterygidæ* are of very great interest. Remarks on these will be found under their individual heads.

GELECHIADÆ.

Head smooth. Antennæ in male usually simple, sometimes ciliated. Labial palpi recurved, pointed. Maxillary palpi very short, not developed. Forewings with vein 1 furcate at base, 7 and 8 stalked (rarely coincident), 7 usually to costa, all veins normally present. Hindwings more or less trapezoidal, hind-margin often indented, veins 3 and 4 separate or from a point, 6 and 7 stalked or approximated at base, rarely remote.

This family occupies a less prominent place in New Zealand than it usually does elsewhere. The only genus fairly represented is *Gelechia*, which is probably cosmopolitan. *Megacraspedus*, of which there is one species, occurs in Australia and Europe; doubtless also in intermediate regions. *Scieropepla* is an Australian genus; the single New Zealand species is also Australian, and has probably immigrated in recent times. The other three genera are endemic, so far as known.

1a. Second joint of palpi tufted beneath.	
2a. Veins 3 and 4 of hindwings stalked	5. *Anisoplaca*
2b. ,, ,, ,, ,, remote	1. *Megacraspedus*
1b. Second joint of palpi not tufted beneath.	
2a. Veins 2 and 8 of forewings absent	3. *Thiotricha*
2b. ,, ,, ,, ,, present.	
3a. Vein 6 of forewings out of 7	2. *Isochasta*
3b. ,, ,, ,, separate.	
4a. Antennæ of male ciliated	4. *Scieropepla*
4b. ,, ,, not ciliated	5. *Gelechia*.

1. Megacraspedus, Z.

Head smooth; ocelli present; tongue well developed. Antennæ $\frac{4}{5}$ of forewings, in male ciliated (1), joints angularly projecting, basal joint long, slender, terminally dilated, without pecten. Labial palpi long, recurved, second joint densely scaled, with a long projecting dense apical tuft beneath; terminal joint as long as second, slender, acute. Maxillary palpi very short, appressed to tongue. Posterior tibiæ thinly clothed with hairs

above. Forewings with vein 1 furcate, 2 from $\frac{1}{2}-\frac{3}{4}$ of cell, 6 separate or out of stalk of 7 and 8, 7 and 8 stalked, 7 to costa, 11 from or before middle of cell. Hindwings as broad as forewings, trapezoidal, apex long, acute, projecting, hind-margin deeply sinuate-emarginate, cilia $2\frac{1}{2}-3$; veins 3 and 4 remote at origin, transverse vein bent outwards, 5 and 6 from rather near together, 7 remote from 6.

The genus may be regarded as consisting of two sections; A., in which vein 6 of the forewings rises out of 7, as in the European *M. binotellus* (F.R.); and B., in which vein 6 of the forewings is separate from 7, as in the European *M. imparellus* (F.R.); it is to section B. that the New Zealand and Australian species all belong.

1. *Meg. calamogonus*, n. sp.

Female.—10–16 mm. Head, palpi, antennæ, and thorax whitish-ochreous. Abdomen and legs grey-whitish, anterior tibiæ and tarsi banded with dark fuscous. Forewings elongate, narrow, very acutely pointed; whitish-ochreous, veins sometimes slightly infuscated; a dark fuscous dot in disc slightly before middle, a second very obliquely before it on fold, and a third in disc at $\frac{2}{3}$; a short fuscous apical streak: cilia ochreous-whitish. Hindwings and cilia whitish.

Larva undescribed, feeding in the seed-heads of *Arundo conspicua;* pupa in a slight cocoon in the same position.

Christchurch; three specimens, in August, November, and March. Several were bred from the larvæ in November by Mr. R. W. Fereday.

2. Isochasta, n. g.

Head smooth; ocelli present; tongue well-developed. Antennæ $\frac{4}{5}$ of forewings, in male serrate, shortly ciliated (1), basal joint elongate, without pecten. Labial palpi moderately long, recurved, second joint thickened with appressed scales, rough beneath, terminal joint somewhat shorter than second, moderate, acute. Maxillary palpi very short, appressed to tongue. Posterior tibiæ clothed with long fine hairs above. Forewings with vein 1 furcate, 2 from $\frac{2}{3}$ of cell, 6 and 7 stalked out of 8, 7 to costa, 11 from before middle of cell. Hindwings as broad as forewings, trapezoidal, apex acute, projecting, hindmargin angularly emarginate, cilia $1\frac{1}{2}$; veins 3 and 4 remote, 5 nearer 6 than 4, 6 and 7 remote.

2. *Isoch. paradesma*, n. sp.

Male.—17 mm. Head and thorax grey-whitish, crown and a spot on shoulders grey. Palpi with second joint dark fuscous, terminal joint white, with a dark fuscous band above middle. Antennæ dark grey. Abdomen grey, and tuft whitish. Legs blackish, with whitish rings at apex of joints, posterior tibiæ whitish. Forewings narrow-lanceolate; whitish, irregularly

irrorated with light grey; a grey suffusion along inner margin from base to anal angle; a small blackish spot on costa almost at base; a black dot beneath costa at $\frac{1}{5}$, and a second larger one beneath it on fold; a thick blackish transverse somewhat oblique streak at $\frac{1}{3}$, reaching from beneath costa to fold, margins irregular; two black dots nearly longitudinally placed in middle of disc, and a third in disc at $\frac{3}{4}$: cilia grey-whitish, with a cloudy blackish-grey line near base round apex and upper part of hindmargin, interrupted into spots. Hindwings grey; cilia grey-whitish.

Invercargill; one specimen in December.

3. Thiotricha, n. g.

Head smooth; ocelli present; tongue well-developed. Antennæ $\frac{3}{4}$ of forewings, in male serrate, clothed with extremely long fine cilia (5–6), basal joint elongate, without pecten. Labial palpi moderately long, smoothly scaled, recurved, second joint hardly thickened or somewhat rough beneath, terminal joint as long as second, acute. Maxillary palpi obsolete. Posterior tibiæ clothed with long hairs above. Forewings with vein 1 furcate, 2 absent (coincident with 3), 3, 4, 5 approximated, 6 rising out of 7 or separate, 7 to costa, 8 absent (coincident with 7), 9 and 10 more or less approximated to 7 at base, 11 from beyond middle of cell. Hindwings as broad as forewings, trapezoidal, apex tolerably acute, hindmargin somewhat sinuate, cilia $1\frac{1}{2}$; vein 2 widely remote from 3, 3 and 4 from a point, 5 bent, 6 and 7 stalked.

Sharply characterised by the extraordinarily developed ciliations of the antennæ of male (which are unique in this family), and the absence of veins 2 and 8 of the forewings.

Sect. A.—Vein 6 of forewings separate from 7.

3. *Thiotr. tetraphala*, n. sp.

Male.—12 mm. Head, palpi, antennæ, thorax, abdomen, and legs whitish-grey, somewhat shining; second joint of palpi dark grey; anterior legs dark grey. Forewings elongate, narrow, acutely pointed; light grey, somewhat irrorated with grey-whitish in disc; three dark grey spots; first basal; second triangular, in disc before middle; third larger, oblong, beyond middle, resting on submedian fold: cilia grey-whitish, with a suffused interrupted grey line near base round apex. Hindwings grey; cilia whitish-grey.

Dunedin; one specimen in February.

Sect. B.—Vein 6 of forewings rising out of 7.

4. *Thiotr. thorybodes*, n. sp.

Male, female.—11–13 mm. Head, palpi, antennæ, thorax, and abdomen whitish-ochreous; second joint of palpi dark

fuscous. Legs dark fuscous, posterior tibiæ and apex of joints whitish-ochreous. Forewings elongate, narrow, round-pointed; rather dark fuscous, irregularly irrorated with ochreous-whitish, more strongly in disc; costa suffusedly darker, and with a darker triangular patch before middle, its apex reaching to fold; an obscure dark fuscous dot in disc slightly beyond middle; a small whitish-ochreous spot, sometimes nearly obsolete, in disc at $\frac{3}{4}$: cilia grey-whitish, with a dark fuscous line near base. Hindwings grey-whitish or whitish-grey; cilia grey-whitish.

Christchurch; five specimens taken amongst forest-growth in January and February.

4. SCIEROPEPLA, n. g.

Head smooth; no ocelli; tongue well-developed. Antennæ $\frac{2}{3}$, in male shortly ciliated (1), with angularly projecting joints, basal joint moderately elongate, without pecten. Labial palpi moderately long, recurved, smoothly scaled, second joint somewhat thickened terminally, terminal joint rather shorter than second, acute. Maxillary palpi short, appressed to tongue. Posterior tibiæ clothed with dense long hairs above. Forewings with vein 1 furcate, upper fork partially obsolete, 2 from $\frac{4}{5}$ of cell, 3 and 4 approximated at base, 7 and 8 stalked, 7 to costa, 11 from middle of cell. Hindwings as broad as forewings, tolerably trapezoidal, apex round-pointed, hindmargin hardly sinuate, cilia $\frac{2}{3}$; 3 and 4 short-stalked, 5 from nearer 4 than 6, 6 and 7 stalked.

An early type, represented by several species in Australia. The larvæ of two are known, both feeding in seed-heads.

5. *Scier. typhicola*, n. sp.

Male, female.—17–19 mm. Head, palpi, antennæ, thorax, abdomen, and legs pale whitish-ochreous, centre of thorax often fuscous; tarsi, and second joint of palpi towards apex, infuscated. Forewings elongate, acutely pointed; whitish-ochreous, sometimes thinly irrorated with brownish-ochreous, costa paler: cilia whitish-ochreous. Hindwings grey-whitish; cilia ochreous-whitish.

Larva 16-legged, stout, cylindrical; whitish, sometimes slightly suffused with pale flesh-colour; dorsal slender, dark flesh-colour; subdorsal and spiracular lines broader, indistinct, flesh-colour; head pale amber, mouth fuscous; second segment with a faint pale amber shield, black-margined on sides; anal segment speckled with black. Feeds in seed-heads of *Typha angustifolia*, burrowing amongst the seeds and causing the down to hang out in large loose masses; sometimes also boring down stems, eating the pith and making many small holes in the sides; found throughout June.

Christchurch; also occurs in New South Wales; bred freely in June, July, and August, but rarely seen at large. The species must be regarded as an immigrant from Australia.

5. Gelechia, Z.

Head smooth; ocelli present; tongue well-developed. Antennæ $\frac{2}{3}$ of forewings, in male filiform, simple or pubescent, basal joint moderately elongate, without pecten. Labial palpi moderately long, recurved, second joint thickened with appressed scales, rough beneath, terminal joint as long or nearly as long as second, moderately slender, acute. Maxillary palpi short, appressed to tongue. Posterior tibiæ clothed with hairs above. Forewings with vein 1 furcate, 2 from about $\frac{3}{4}$ of cell, 7 and 8 stalked, 7 to costa, 11 from about middle of cell. Hindwings as broad as forewings or rather broader, trapezoidal, apex pointed or round-pointed, hindmargin shallowly emarginate or hardly perceptibly sinuate, cilia $\frac{2}{3}$–$1\frac{1}{2}$; veins 3 and 4 from a point, 5 from rather near 4, 6 and 7 from a point or approximated towards base.

The variation in the form of hindwings and length of cilia is used by Heinemann to characterise two groups, *Gelechia* and *Lita*, as separate genera; but these shade so imperceptibly into each other, that I am of opinion that the distinction cannot be advantageously maintained: most of the following species are of an intermediate character, and might be ranked almost equally well with either group. As thus limited, the genus is very large, especially predominating in Europe and North America.

1a. Hindwings in male with a costal pencil of long hairs 6. *solanella.*
1b. „ „ without costal pencil.
  2a. Discal spots surrounded with pale rings .. .. 14. *achyrota.*
  2b. „ not ringed.
    3a. Thorax partially dark fuscous.
      4a. Dark costal area of forewings continued evenly to apex .. 10. *parapleura.*
      4b. „ „ „ terminating about $\frac{3}{4}$ .. 8. *brontophora.*
    3b. Thorax not dark fuscous.
      4a. Palpi with four blackish bands .. .. 7. *thyraula.*
      4b. „ without distinct blackish bands.
        5a. Head and thorax grey .. .. .. 13. *lithodes.*
        5b. „ „ whitish-ochreous.
          6a. Hindwings with a cloudy fuscous streak in disc .. .. 9. *schematica.*
          6b. „ without discal streak.
            7a. Forewings with a mostly entire dark median streak .. 12. *monophragma.*
            7b. „ with at most an apical streak.. .. .. 11. *pharetria.*

6. *Gel. solanella*, Boisd.

(*Bryotropha solanella*, Boisd., J. B. Soc. Centr. Hort., 1874; Ragonot, Bull. Soc. Ent. Fr., 5 (v.), pp. xxxv.-xxxvii.; Meyr., Proc. Linn. Soc. N.S.W., 1879, 112; *Gelechia terrella*, Walk., 1024.)

Male, female.—14–16 mm. Head, palpi, and thorax pale brownish-ochreous, irrorated with grey-whitish; palpi with two

dark fuscous bands on second joint, and one above middle on terminal joint. Antennæ, abdomen, and legs pale greyish-ochreous, legs irrorated with dark fuscous. Forewings elongate, narrow, acutely pointed; pale brownish-ochreous, densely irrorated with whitish-grey, and more or less with dark grey or blackish-grey; the dark irroration forms two small spots on costa towards base, and a suffused streak along inner margin, connected with three or four small irregular spots about fold; cilia pale greyish-ochreous, towards base mixed with blackish-grey points, forming one or two distinct blackish lines round apex. Hindwings with apex acute, hindmargin moderately emarginate, in male with a dilation in middle of costa, and a long dense pencil of hairs from costa at base; pale grey; cilia pale greyish-ochreous.

Closely allied to the other European species of the *Solanum*-feeding group, but distinguished from all by the costal hair-pencil of the hindwings in male.

Larva feeding gregariously in the tubers of the cultivated potato, boring galleries through their substance, and causing them to rot. This insect does very great damage, especially where potatoes are allowed to remain stored for any length of time, and sometimes destroys nine-tenths of the crop.

Taranaki and Napier, probably generally distributed; common also throughout Eastern Australia; occurs from November to May, coming freely to lamps, and flying at dusk in potato-fields. The species has certainly been introduced with the potato, and is probably a native of Algeria.

Walker's name is really the older, but cannot be allowed to stand, as he appears to have overlooked the already existing *Gelechia terrella*, Hb., a well-known and abundant European species.

7. *Gel. thyraula*, n. sp.

Male.—9–11 mm. Head, palpi, thorax, and abdomen white irrorated with grey; palpi with two blackish bands on each joint. Antennæ white, annulated with black. Legs blackish, apex of joints and a median ring of tibiæ white. Forewings elongate, narrow, acutely pointed; whitish, irrorated with black; markings black, ill-defined; a small spot on costa near base, and a second obliquely beyond it on fold; a rather oblique streak from costa beyond ¼, reaching half across wing; three small discal spots, first in middle, second on fold obliquely before first and almost touching apex of transverse streak, third in disc beyond middle; cilia grey-whitish, towards base mixed with black points. Hindwings with apex acute, hindmargin moderately emarginate; pale whitish-grey; cilia grey-whitish.

An inconspicuous but easily recognised species.

Christchurch and Castle Hill; five specimens in January and February.

8. *Gel. brontophora*, n. sp.

Male.—11 mm. Head and palpi whitish-ochreous; palpi with two blackish bands on each joint. Antennæ dark fuscous, spotted with whitish-ochreous. Thorax blackish fuscous, with a whitish-ochreous anterior central spot. Abdomen whitish-grey. Legs blackish, apex of joints and middle ring of tibiæ ochreous-whitish. Forewings elongate, narrow, acutely pointed; whitish-ochreous, thinly irrorated with brownish-ochreous; a dense black irroration covering costal half of wing to fold from base to middle, except an oblique irregular bar at $\frac{1}{4}$, posteriorly suffusedly attenuated to costa at $\frac{3}{4}$; five irregular black discal spots, first in middle, second obliquely before first on fold, confluent with costal irroration, third below first, connected with it by a cloudy black irroration, fourth larger, in disc at $\frac{2}{3}$, fifth beyond fourth: cilia pale whitish-ochreous, with scattered black points towards base. Hindwings with apex acute, hindmargin moderately sinuate; whitish-grey; cilia grey-whitish.

Christchurch; one specimen in February.

9. *Gel. schematica*, n. sp.

Male.—16–17 mm. Head and palpi whitish-ochreous. Antennæ fuscous. Thorax whitish-ochreous, more or less infuscated. Abdomen ochreous-whitish, basal half light ochreous above. Legs ochreous-whitish, anterior and middle pair suffused with fuscous. Forewings elongate, narrow, acutely pointed; light greyish-ochreous towards disc, sometimes irrorated with deep ochreous; a dark grey or blackish irroration forming a broad suffused streak along costa from base to $\frac{2}{3}$, posteriorly attenuated, variable in intensity, generally divided by a cloudy oblique streak of ground-colour from base to middle of costa; three small dark fuscous discal spots, first before middle, second on fold obliquely before first, third in disc at $\frac{3}{5}$: cilia ochreous-whitish, with two irregular interrupted lines of blackish points. Hindwings with apex tolerably acute, hindmargin moderately sinuate; whitish-grey, with a cloudy longitudinal streak of dark fuscous scales in disc towards base; cilia ochreous-whitish.

This and the three following species are nearly allied; this species is recognisable by the greyer tinge and dark costal suffusion of the forewings, and especially the dark discal streak of hindwings (though this may possibly not persist in the female).

Castle Hill and Bealey River (2,100–2,500 feet); five specimens in January.

10. *Gel. parapleura*, n. sp.

Male, female.—16 mm. Head and palpi ochreous-white, apex of palpi black. Antennæ dark fuscous. Thorax dark

purplish-fuscous, with a broad central ochreous-white stripe. Abdomen ochreous-whitish. Legs dark fuscous, apex of joints and posterior pair ochreous-whitish. Forewings elongate, narrow, acutely pointed; dark fuscous; a broad pale whitish-ochreous streak along inner margin from base to apex, occupying nearly half of wing; three indistinct small black discal spots, sometimes obselete, first in middle, second on lower margin of dark fuscous portion very obliquely before first, third in disc beyond middle: cilia pale whitish-ochreous, on costa mixed with dark fuscous. Hindwings with apex tolerably acute, hind-margin gently sinuate; whitish-grey; cilia ochreous-whitish.

Characterised by the straight longitudinal separation of the dark costal and light dorsal halves of the forewings, and the colour of thorax.

Bealey River (2,100 feet), in January; two specimens.

11. *Gel. pharetria*, n. sp.

Male, female.—13–17 mm. Head, palpi, thorax, abdomen, and legs, whitish-ochreous; anterior legs infuscated. Antennæ fuscous. Forewings elongate, narrow, acutely pointed; whitish-ochreous, obscurely irrorated with brownish-ochreous, tending to form streaks on veins, sometimes a more distinct apical streak; sometimes a few scattered black scales, also tending to accumulate on veins; three small black discal spots, sometimes almost obselete, first before middle, second on fold obliquely before first, third beyond middle; apical portion of costa and hindmargin obscurely dotted with black: cilia whitish-ochreous, with two obscure interrupted lines of blackish points round apex. Hindwings with apex round-pointed, hindmargin gently sinuate; whitish-grey; cilia ochreous-whitish.

Closely allied to the following, from which it differs by the brownish irroration, obscure lines on veins, and absence of the dark fuscous median streak; the hindwings are also somewhat less pointed.

Castle Hill and Arthur's Pass (2,500–3,000 feet); locally abundant amongst rough flowery herbage in January.

12. *Gel. monophragma*, n. sp.

Male, female.—11–15 mm. Head, palpi, thorax, and abdomen ochreous-whitish; second joint of palpi externally somewhat irrorated with black, apex of terminal joint black. Antennæ fuscous. Legs dark fuscous, posterior tibiæ and apex of joints ochreous-whitish. Forewings elongate, narrow, acutely pointed; ochreous-whitish, somewhat irrorated with ochreous; a narrow blackish central streak from base to apex, sometimes suffused with ochreous beneath, variable in strength, rarely partially obsolete, and tending to form two separate discal spots towards middle: cilia ochreous whitish. Hindwings with apex acute,

hindmargin moderately sinuate; pale whitish-grey; cilia ochreous-whitish.

Distinguished by the pale colour and blackish median streak, which, though sometimes imperfect, is always traceable; it recalls the considerably darker European *G. mulinella.*

Wellington, Hamilton, and Invercargill; common in dry grassy places in December and January.

13. *Gel. lithodes*, n. sp.

Male.—16 mm. Head, palpi, antennæ, thorax, abdomen, and legs grey, finely sprinkled with whitish; antennæ rather densely pubescent. Forewings elongate, narrow, tolerably acutely pointed; grey, finely irrorated with blue-whitish; three discal spots obscurely darker, first before middle, second on fold rather before first, third in disc beyond middle: cilia whitish-grey. Hindwings with apex round-pointed, hindmargin slightly sinuate; whitish-grey; cilia grey-whitish.

The slaty-grey colouring is imitative of the mountain rock, as in *Scoparia cataxesta* and other species; the antennal pubescence is also a common characteristic of alpine forms.

Arthur's Pass (2,500 feet), in January; one specimen resting on shingle.

14. *Gel. achyrota*, n. sp.

Male, female.—17–18 mm. Head, thorax, and abdomen pale greyish-ochreous mixed with whitish. Palpi whitish-ochreous, basal $\frac{2}{3}$ of second joint, and basal and supramedian bands of terminal joint dark fuscous. Antennæ light greyish-ochreous. Legs dark fuscous, posterior tibiæ above and apex of joints ochreous-whitish. Forewings elongate, apex round-pointed, hindmargin very obliquely rounded; light brownish-ochreous, irregularly mixed with whitish and blackish scales; anterior half of costa suffused with whitish, and dotted with blackish; inner margin between $\frac{1}{4}$ and $\frac{2}{3}$ suffused with blackish; a small black spot on base of costa; four small black discal spots, surrounded with whitish rings, first in disc before middle, second on fold rather before first, their rings confluent, third and fourth dot-like, transversely placed and close together in disc at $\frac{3}{5}$; a cloudy whitish fascia from $\frac{4}{5}$ of costa to anal angle, dentate outwards in middle; a cloudy black hindmarginal line: cilia ochreous-whitish with two dark grey lines, first interrupted, second entire. Hindwings with apex rounded, hindmargin hardly sinuate; grey, towards base paler; cilia ochreous-whitish, with two cloudy grey lines.

Remote from the other New Zealand species of the genus, and approaching *Tachyptilia populella* in form and superficial appearance.

Christchurch and Dunedin; rather common amongst bush, in December and January.

6. ANISOPLACA, n.g.

Head smooth; ocelli present; tongue well developed. Antennæ $\frac{3}{4}$, in male filiform, moderately ciliated (**1**), basal joint elongate, without pecten. Labial palpi long, recurved, second joint thickened with dense scales, forming a short dense triangular projecting tuft towards apex beneath, terminal joint longer than second, slightly roughened anteriorly, acute. Maxillary palpi short, appressed to tongue. Posterior tarsi roughly haired above. Forewings with vein 1 furcate, 2 from $\frac{3}{4}$ of cell, 7 and 8 stalked, 7 to costa, 11 from middle of cell. Hindwings broader by $\frac{1}{3}$ than forewings, trapezoidal, apex and hindmargin rounded, cilia $\frac{2}{5}$; veins 3 and 4 short stalked, 5 from rather near 4, cell longest above, 6 and 7 approximated at base.

15. *Anis. ptyoptera*, n. sp.

Male.—27 mm. Head, thorax, and abdomen very pale whitish ochreous, shoulders narrowly dark fuscous. Palpi ochreous-whitish, basal half of second joint and a spot at base of terminal joint fuscous. Antennæ fuscous. Legs pale whitish-ochreous, irrorated with dark fuscous. Forewings elongate, narrow, posteriorly somewhat dilated, apex obtuse, hindmargin hardly rounded, oblique; very pale whitish-ochreous, with a few blackish scales, and irregularly irrorated with grey except towards costa and apex, and on two round patches surrounding discal spots; costa irrorated with grey towards base; a black dot beneath costa at $\frac{1}{4}$; three small black discal dots, first at $\frac{1}{3}$, the other two transversely placed close together beyond middle: cilia ochreous-whitish, with a grey line, basal third suffusedly barred with grey. Hindwings light grey; cilia whitish, with a grey basal line.

Christchurch, in March; one specimen received from Mr. R. W. Fereday.

DEPRESSARIADÆ.

Head smooth. Antennæ in male simple. Labial palpi recurved, pointed. Maxillary palpi very short, not developed. Forewings with vein 1 furcate at base, 2 from or near angle of cell, 7 and 8 stalked (rarely coincident), 7 to costa or apex (rarely to hindmargin). Hindwings not broader than forewings, hindmargin rounded, veins 3 and 4 from a point or stalked, 6 and 7 separate, nearly parallel.

The family, not a very large one, is but scantily represented in New Zealand and Australia; it is closely allied to the *Œcophoridæ*, from which it differs essentially only by the simple antennæ of male.

7. PHÆOSACES, n. g.

Head loosely haired; no ocelli; tongue well developed. Antennæ $\frac{3}{4}$, in male subserrate, simple, basal joint moderately

elongate, without pecten. Labial palpi long, recurved, second joint thickened with appressed scales, terminal joint shorter than second, acute. Maxillary palpi very short, appressed to tongue. Abdomen not flattened. Posterior tibiæ clothed with long hairs above. Forewings with vein 1 furcate, 2 from near angle, 7 and 8 stalked, 7 to apex, 11 from middle of cell. Hindwings as broad as forewings, trapezoidal-ovate, apex and hindmargin rounded, cilia $\frac{2}{5}$; veins 3 and 4 from a point, 6 and 7 tolerably parallel.

Allied to *Depressaria*, but distinguished by the smoothly-scaled second joint of palpi, the abdomen not flattened, and the termination of vein 7 of the forewings in the apex. So far as known the genus is endemic.

16. *Phæo. compsotypa*, n. sp.

Female.—19 mm. Head, palpi, and antennæ grey-whitish, palpi externally suffused with dark fuscous. Thorax grey-whitish; shoulders, and a longitudinal anterior mark on each side of back, dark fuscous. Abdomen whitish-grey. Legs dark fuscous, suffusedly ringed with grey-whitish. Forewings oblong, costa moderately arched, apex rounded, hindmargin rather oblique, slightly rounded; light greyish-fuscous, irregularly mixed with whitish and blackish scales, towards costa anteriorly broadly suffused with whitish; a small black spot on base of costa; a cloudy dark fuscous spot on fold at $\frac{1}{4}$, connected with inner margin by an inwardly oblique line; a blackish dot in disk at $\frac{3}{5}$, connected with costa at $\frac{3}{5}$ by a dark fuscous line strongly dentate outwards in middle, and a second dot on fold directly beneath first, connected with inner margin by a cloudy irregular inwardly oblique dark fuscous line; a thick cloudy dark fuscous outwardly oblique streak from middle of costa, reaching nearly half across wing; a posterior series of short longitudinal blackish streaks between veins; an interrupted blackish hindmarginal line: cilia light greyish-fuscous mixed with whitish, with a cloudy blackish-grey line. Hindwings whitish, with a broad suffused light-grey border along hindmargin; cilia whitish, with a grey line.

Hamilton; one specimen in January.

17. *Phæo. apocrypta*, n. sp.

Male, Female.—20–28 mm. Head, palpi, antennæ, thorax, and abdomen light greyish-fuscous, palpi externally irrorated with dark fuscous. Legs dark fuscous, suffusedly ringed with whitish, hairs of posterior tibiæ ochreous-whitish. Forewings oblong, posteriorly somewhat dilated, costa moderately arched, apex rounded, hindmargin obliquely rounded; fuscous, sometimes ochreous-tinged, sometimes finely irrorated with grey-whitish; a small darker fuscous spot in disc at $\frac{3}{8}$, a second

almost directly beneath it on fold, and a third in disc beyond middle, all sometimes obsolete; a cloudy curved-angulated line from $\frac{2}{3}$ of costa to inner margin before anal angle hardly darker, preceded by a faint paler shade; an interrupted obscure darker hindmarginal line: cilia light ochreous-brownish, with two indistinct darker lines, tips ochreous-whitish. Hindwings rather light grey; cilia ochreous-whitish, with a cloudy grey line.

The form of wings varies, being usually more oblong in the female than in the male.

Christchurch, Dunedin, and Lake Wakatipu; rather common in December and January.

PLUTELLIDÆ.

Head tolerably smooth. Antennæ in male simple or pubescent, sometimes scaled. Labial palpi recurved, pointed. Maxillary palpi short or moderate, porrected. Forewings with vein 1 furcate, 7 and 8 separate (or in exotic genera sometimes stalked), 7 usually to hindmargin, secondary cell and forked parting-vein usually well-defined. Hindwings elongate-ovate or ovate-lanceolate; veins 3 and 4 separate, 5 and 6, or 6 and 7, usually separate, sometimes stalked.

In all the three following genera the antennæ are projected directly in front of the head in repose. *Plutella* is probably a northern genus, but one species at least, *P. cruciferarum*, is now by the agency of man disseminated through the world; the other two New Zealand species, both new, occur also in Australia, and will probably be found to be not indigenous in either region, but introduced with the weeds of cultivation. The other two genera are endemic, so far as known. *Protosynæma* is especially interesting, indicating in my opinion with certainty the origin of *Glyphipteryx* and its allies, whilst in structure clearly referable here. The free-feeding larvæ, tapering towards both ends, and usually spindle-shaped cocoons of this family, are in general easily recognisable by those familiar with them. I found larvæ of one species of the family feeding on a species of *Carex* in the mountains, but failed to rear them, as they were infested with parasites.

1a. Second joint of palpi tufted	.. .. ..	10. *Plutella*.
1b. „ „ „ not tufted.		
2a. Antennæ partially clothed with scales	..	8. *Protosynæma*.
2b. „ not thickened with scales	..	9. *Orthenches*.

8. Protosynæma, n. g.

Head smooth; ocelli present; tongue well-developed. Antennæ $\frac{3}{4}$, lower portion thickened with dense clothing of scales, remainder in male with angularly projecting joints, pubescent-ciliated, basal joint moderately elongate, stout, without pecten. Labial palpi moderately long, recurved, with appressed scales,

somewhat rough beneath, terminal joint longer than second, acute. Maxillary palpi short, filiform, acute, porrected. Posterior tibiæ shortly rough-haired beneath. Forewings with vein 1 furcate, 2 almost from angle of cell, 7 to hindmargin, 11 from beyond middle of cell, all veins separate. Hindwings as broad as forewings, elongate-ovate, cilia, $\frac{2}{3}$–$\frac{3}{4}$; veins 3 and 4 remote, 6 and 7 tolerably parallel.

The two species differ much in the extent of the antennal scaling in the male, but comparatively little in the female.

18. *Prot. eratopis*, n. sp.

Male, female.—11½–12½ mm. Head yellow-ochreous, face and palpi paler, mixed with white. Antennæ clothed with dense scales in male to $\frac{1}{3}$ above only, in female to $\frac{1}{2}$ all over, brownish-ochreous, apex of scaled portion dark fuscous, naked portion grey. Thorax bronzy-ochreous, with a yellowish-white stripe on each side of back. Abdomen grey. Legs dark grey, posterior tibiæ and apex of joints grey-whitish. Forewings elongate, moderate, apex rounded, hindmargin sinuate, oblique; yellow-ochreous, with somewhat coppery reflections; markings margined with fuscous; a straight white streak from middle of base to near inner margin before middle; a straight narrow silvery-metallic fascia from costa near base to middle of inner margin, sometimes not reaching it; a rather broader oblique white fascia from costa at $\frac{1}{3}$, reaching to fold, attenuated to extremity; a narrow straight silvery-metallic fascia from middle of costa to $\frac{2}{3}$ of inner margin, becoming white towards costa; a narrow straight white fascia from $\frac{2}{3}$ of costa to $\frac{4}{5}$ of inner margin, interrupted by a small round silvery-metallic spot above middle; between this fascia and hindmargin is a large round white spot, crossed by six fine black lines on veins, connected with costa at $\frac{5}{6}$ by a short white bar, beneath margined by a round coppery or violet-metallic black-margined spot at its lower anterior angle, and a black streak along lower half of hindmargin containing three similar coppery or violet-metallic spots; a silvery-metallic streak from costa before apex to hindmargin above middle, becoming white towards costa: cilia ochreous, tips paler, with white spots at extremities of subapical streak. Hindwings and cilia grey.

The superficial resemblance to a typical *Glyphipteryx* is very extraordinary.

Otira Gorge, about 2,300 feet; taken commonly, flying about a flowery bank in January.

19. *Prot. steropucha*, n. sp.

Male, female.—13–14 m.m. Head and thorax dark purplish-fuscous, palpi dark fuscous, second joint yellow-whitish beneath towards base. Antennæ clothed with very dense scales in male to $\frac{3}{4}$, in female to $\frac{2}{3}$, dark purplish-fuscous, naked apical portion

yellow-whitish. Abdomen dark grey. Legs dark purplish-fuscous. Forewings elongate, narrow, apex round-pointed, hindmargin sinuate, oblique; deep ferruginous-bronze, with purplish reflections, finely irregularly irrorated with dark grey and whitish; markings coppery-metallic; a very oblique streak from costa near base to fold; an irregular transverse mark parallel to hindmargin in middle of disc, in female reaching costa in middle, and then appearing as a curved fascia not reaching inner margin; a transverse angulated fascia from beneath costa at $\frac{3}{4}$ to above anal angle, not reaching margins; a hindmarginal fascia, containing two small round deep black spots above anal angle: cilia deep ferruginous-bronze, mixed with dark grey. Hindwings dark fuscous-grey, lighter towards base, sometimes coppery-tinged; cilia grey.

Hamilton and Christchurch, in January, March and June; four specimens.

9. Orthenches, n. g.

Head smooth; ocelli present; tongue well-developed. Antennæ $\frac{4}{5}$, in male filiform, simple or pubescent, somewhat thickened at base, joints angularly projecting, basal joint moderately elongate, with strong pecten. Labial palpi moderate or long, recurved, with appressed scales, somewhat rough beneath throughout except at apex, terminal joint from as long to twice as long as second, acute. Maxillary palpi tolerably filiform, curved, ascending. Posterior tibiæ rough-haired beneath. Forewings with vein 1 furcate, 2 almost from angle of cell, 7 to apex, 11 from $\frac{1}{3}$ of cell, all veins separate, secondary cell strongly defined. Hindwings as broad as forewings, elongate-ovate or ovate-lanceolate, hindmargin sometimes rather sinuate, cilia $\frac{3}{4}$–1; all veins remote, tolerably parallel; beneath sometimes with a neural ridge or pecten in male.

Larva feeding openly or amongst loosely spun leaves.

1a. Apex of forewings acute	22. *porphyritis.*
1b. ,, ,, rounded.	
2a. Head whitish-yellowish	20. *chlorocoma.*
2b. ,, grey-whitish	21. *prasinodes.*

20. *Orth. chlorocoma*, n. sp.

Male.—15 mm. Head and antennæ pale whitish-yellowish. Palpi moderate, yellow whitish, second joint with a dark grey subapical band, terminal joint as long as second. Thorax pale whitish-yellowish, sides brownish. Abdomen ochreous-whitish. Legs fuscous, beneath whitish, anterior pair blackish. Forewings elongate, narrow, costa slightly sinuate, apex and hindmargin rounded; fuscous-whitish, towards costa and base slightly yellowish-tinged, with thin irregular blackish irroration throughout, tending to accumulate in small spots, especially on margins; a small round black spot in disc at $\frac{2}{3}$: cilia pale whitish-yellowish, suffusedly barred with blackish-grey. Hindwings elongate-ovate,

with a scaled membranous ridge along lower median vein beneath; grey-whitish; cilia grey-whitish, at apex pale whitish-yellowish, with a blackish-grey spot.

Larva 16-legged, slender, attenuated towards both extremities, especially posteriorly; whitish-brown or whitish-green; a straight slender dorsal line and two rather irregular ill-defined lines on each side of it ochreous-brown or green, according to ground colour; beneath these a rather broad yellowish-white spiracular line; space beneath this dull brown; spots minute, black; head grey-whitish or greenish-whitish, irregularly striped longitudinally with dark fuscous. Feeds openly on *Carmichælia australis* (*Leguminosæ*), gnawing the twigs (the plant being leafless). Pupa in a rather thin firm spindle-shaped cocoon.

Christchurch; three larvæ found in March, from which I bred one specimen in April.

21. *Orth. prasinodes*, n. sp.

Male.—14 mm. Head and antennæ grey-whitish. Palpi moderately long, grey-whitish, second joint, except apex, and base of terminal joint dark fuscous, terminal joint somewhat longer than second. Thorax light greenish-grey, suffusedly mixed with dark grey. Abdomen grey-whitish. Legs dark fuscous, apex of joints and posterior tibiæ grey-whitish. Forewings elongate, costa sinuate, apex and hindmargin rounded; light dull greenish, disc, inner and hind margins much suffused with dark grey, rest of wing indistinctly dotted with black, costa more distinctly; a small pale spot in dark suffusion below middle of fold; a small black spot in disc at $\frac{3}{5}$, preceded by a pale longitudinal streak in disc: cilia grey, mixed with grey-whitish. Hindwings elongate-ovate, beneath with a long thin pecten of hairs from vein 1c directed towards disc; pale whitish-grey; cilia grey-whitish, with a dark grey spot at apex.

Christchurch; one specimen in March, amongst bush.

22. *Orth. porphyritis*, n. sp.

Male, female.—11–14 mm. Head light ochreous. Palpi long, light ochreous or whitish, externally suffused with dark fuscous, terminal joint twice as long as second. Antennæ whitish, annulated with dark fuscous. Thorax ochreous, mixed and suffused with purplish and dark fuscous. Abdomen grey. Legs dark fuscous, apex of joints and posterior tibiæ whitish. Forewings elongate, narrow, costa arched, apex acute, hindmargin very obliquely sinuate; brownish-ochreous, with purple or coppery reflections, sometimes mixed with grey-whitish; an irregular irroration of small dark fuscous spots; markings suffused, deep bronzy or violet-fuscous, very variable; normally a fascia-like rather oblique streak from costa at $\frac{1}{4}$, usually abbreviated, but sometimes reaching inner margin, an irregular

median fascia parallel to this, connected by a bar with costa at ¾, and a narrow fascia from costa before apex to anal angle, but these are sometimes incomplete or partially suffused; in one specimen, traces of a longitudinal white median streak: cilia brownish-ochreous, with a dark fuscous spot at apex. Hindwing ovate-lanceolate, apex acute, hindmargin sinuate; grey, towards apex darker; cilia grey.

Larva 16-legged, moderate, cylindrical, rather tapering at both ends; dull light greenish-ochreous; dorsal narrow, ochreous-whitish, bordered on each side by a slender dull reddish-fuscous streak, coalescing towards extremities; head brownish-ochreous. Feeds amongst loosely spun-together leaves of *Podocarpus totara* (*Coniferæ*). Pupa in a thin cocoon.

Otira River, Dunedin, and Invercargill, in September, December, and January; five specimens; larvæ found in December produced an imago in January.

10. PLUTELLA, Schrk.

Head with loosely appressed hairs; ocelli present; tongue well developed. Antennæ ¾, towards base somewhat thickened, serrate, in male simple, basal joint moderate, with a dense anterior flap of scales. Labial palpi moderately long, recurved, second joint beneath with long dense projecting tuft of scales towards apex, terminal joint as long as second, slender or somewhat rough anteriorly, acute. Maxillary palpi very short, filiform. Posterior tibiæ shortly haired beneath. Forewings with vein 1 furcate, 2 from rather near angle, 7 to hindmargin, 11 from or before middle of cell, secondary cell more or less well-defined, all veins separate. Hindwings as broad as forewings or somewhat broader, elongate-ovate or ovate-lanceolate, cilia ⅔–1¼; veins 3 and 4 more or less remote, 5 and 6 stalked or separate, 7 remote.

The known larvæ are 16-legged, somewhat tapering to both ends, and all feed on *Cruciferæ*. Probably none of the three following species is indigenous:—

1a. Apex of hindwings acute .. .. 23. *cruciferarum.*
1b. ,, ,, ,, rounded.
  2a. Hindmargin of forewings concave .. .. 25. *psammochroa.*
  2b. ,, ,, ,, not concave .. 24. *sera.*

SECT. A.—Veins 5 and 6 of hindwings stalked.

23. *Plut. cruciferarum*, Z.

Male, female.—13–14 mm. Head and thorax in male ochreous-white, sides of thorax fuscous, in female wholly grey-whitish, mixed with grey. Palpi dark fuscous, base and terminal joint whitish. Antennæ whitish, annulated with fuscous, and with generally five dark fuscous bands. Forewings elongate, narrow, tolerably pointed, in male with a pencil of hairs beneath from base of costa; light fuscous, sometimes partially

ochreous-tinged, somewhat mixed with whitish, with a scanty irroration of small blackish spots, larger and more numerous in female; costal edge white in male, especially towards $\frac{2}{3}$; in male a longitudinal white line about fold from base, above margined with dark fuscous or blackish, beneath shading into a pale ochreous dorsal space, twice slightly sinuate upwards, towards anal angle bent upwards and becoming obsolete; in female this line is indistinct, the dorsal space hardly paler than ground-colour, but upper black margin tolerably distinct, the sinuations angulated and much more prominent than in male: cilia grey-whitish, somewhat irrorated with grey, with four dark fuscous lines. Hindwings ovate-lanceolate, grey; cilia whitish grey, towards tips more whitish.

A variable species.

Larva green, feeding on cabbages and other *Cruciferæ*, to which it is sometimes exceedingly destructive, eating the leaves into holes. Pupa in an open network cocoon.

Cambridge, Wellington, Taranaki, Christchurch, Bealey River, Lake Wakatipu, and probably universally; abundant in the neighbourhood of gardens from August to March. Introduced from Europe, and now occurring probably throughout the world; in Australia often very numerous.

SECT. B.—Veins 5 and 6 of hindwings separate.

24. *Plut. sera*, n. sp.

Male, female.—11–13 mm. Head whitish-ochreous. Palpi whitish-ochreous, more or less mixed with dark fuscous. Antennæ ochreous-white, with median and posterior bands and two subapical rings dark fuscous. Thorax light brownish-ochreous, anterior margin mixed with dark fuscous. Abdomen whitish-grey. Legs dark fuscous, apex of joints and posterior tibiæ whitish-ochreous. Forewings elongate, rather narrow, costa arched, apex round-pointed, hindmargin hardly rounded, very oblique; light brownish-ochreous mixed with grey, and with a scanty irroration of small black spots; a crescentic black mark on fold before middle, extremities directed upwards, posterior tending sometimes to be produced as a cloudy streak to costa beyond middle; a fuscous streak from inner margin at $\frac{3}{4}$ towards costa near apex, but becoming obsolete before reaching it, margined with black towards lower extremity, sometimes little darker than ground colour; a blackish line along upper part of hindmargin: cilia whitish-ochreous with a black line, a blackish spot at apex and a larger one below middle of hindmargin. Hindwings elongate-ovate, light grey; cilia grey-whitish.

Most allied to the European *P. annulatella*.

Taranaki, Makatoku, and Palmerston, in March; also common in Eastern Australia, where the imago is on the wing most of the year, frequenting the neighbourhood of cultivation.

25. *Plut. psammochroa*, n. sp.

Male, female.—16–20 mm. Head, palpi, antennæ, thorax, abdomen, and legs whitish-ochreous; head and thorax sometimes with two obscure darker longitudinal stripes; second joint of palpi sometimes with dark fuscous subapical band; anterior legs suffused with dark fuscous. Forewings elongate, rather narrow, costa arched, apex acute, hindmargin concave, oblique; whitish-ochreous; all veins distinctly lined with ochreous-fuscous; a few irregularly scattered black dots: cilia whitish-ochreous. Hindwings somewhat broader than forewings, elongate-ovate; pale whitish-grey; cilia grey-whitish.

Differs from all by the concave hindmargin of forewings.

Otira River, in January; also from Eastern Australia; three specimens.

MICROPTERYGIDÆ.

Head rough or loosely haired. Antennæ in male filiform, simple or pubescent. Labial palpi moderate or short, straight, porrected or drooping. Maxillary palpi moderate or long, porrected or folded. Forewings with venation normal or complex, often with additional veins and subdivisions of cell. Hindwings ovate-lanceolate or lanceolate, neuration nearly as in forewings, with not less than 9 veins rising out of cell.

This is the ancestral family of the *Tineina*, and may be always known by the more complex neuration of the hindwings, which is not essentially differentiated from that of the forewings. In the older genera of the family the neuration cannot be strictly referred to the Lepidopterous type at all, but is really Neuropterous in character, and undoubtedly indicates the origin of the *Lepidoptera* from that group. In these genera there are several additional veins, and usually several separate cells, the whole presenting a structure which could not possibly be evolved from the normal Lepidopterous type, since such a process would require the creation of the new veins, whilst the Lepidopterous type can readily be deduced from it by the disappearance or modification of existing veins. In the case of these genera the description of the neuration should require, in consequence, an entirely new terminology; but, although the course is not strictly logical, I have thought it more intelligible to maintain for the forewings the assumption of the normal Lepidopterous type in these genera, keeping for equivalent veins their usual designation, and treating those which are without analogue in the normal type as superadded.

Besides the following, only a few European species are authentically known; I have not succeeded in finding any representative of the family in Australia. The two genera occurring here are both endemic; *Palæomicra* is probably the oldest known genus of the order; *Mnesarchæa* is very interesting

as exhibiting a step in transition to the *Erechthiadæ* and *Plutellidæ*. The species described here are all very difficult to see when on the wing, and therefore likely to be passed over. The known exotic larvæ are apodal and miners.

Under the head of *Palæomicra* I give a comparison of the neuration of that genus with those *Neuroptera* (*Trichoptera*) which approach it most nearly.

1a. Forewings with additional costal veins; labial palpi very short .. .. 12. *Palæomicra.*
1b. Forewings without additional veins; labial palpi rather long, brushlike .. .. .. 11. *Mnesarchæa.*

11. Mnesarchæa, n. g.

Head loosely haired, somewhat rough; ocelli present; tongue obsolete. Antennæ $\frac{3}{4}$, stout, filiform, in male simple, basal joint moderate, without pecten. Labial palpi moderately long, straight, porrected, clothed with long loose scales forming a dilated terminal brush. Maxillary palpi moderate, porrected, terminating in a loose dilated brush. Abdomen in male with uncus and valves well developed, and two long linear internal processes. Posterior tibiæ thinly clothed with long bristles, middle and posterior tarsi with whorls of projecting bristles at apex of four basal joints. Forewings with vein 1 simple, 2 almost from angle of cell, 6 out of stalk of 7 and 8 near base, 7 and 8 stalked, 7 to hindmargin, 11 absent. Hindwings $\frac{4}{5}$ of forewings, lanceolate, cilia rather over 1; neuration exactly as in forewings, except that vein 6 is separate from 7.

26. *Mnes. paracosma*, n. sp.

Male, 9–10 mm. Head, palpi, and antennæ whitish-ochreous. Thorax light brownish-ochreous. Abdomen grey. Legs dark grey, bristles whitish-ochreous. Forewings lanceolate; yellowish-ochreous, suffusedly mixed with dark fuscous and a few grey-whitish scales, except towards costa anteriorly; a grey-whitish oblique wedge-shaped streak from middle of costa, reaching almost to anal angle; the dark fuscous scales tend to form a spot in disc before this; a deeper suffusion beyond it, especially towards costa, and a spot towards inner margin before middle: cilia light brownish-ochreous, somewhat mixed with dark fuscous and whitish. Hindwings fuscous-grey, somewhat purple-shining; cilia grey.

Lake Wakatipu (1,100 feet), and Invercargill; nine specimens, flying amongst rough herbage in December.

12. Palæomicra, n. g.

Head with long rough hairs; ocelli present; tongue obsolete. Antennæ $\frac{1}{2}$–$\frac{2}{3}$, in male filiform, pubescent, basal joint small, concealed. Labial palpi extremely short, rudimentary. Maxillary palpi long, folded, loosely scaled. Abdomen in male

with rounded terminal plate above, valves large. Middle tibiæ without spurs; posterior tibiæ somewhat rough beneath. Forewings with vein $1a$ with long basal furcation, lower fork sometimes (*chalcophanes*) again basally furcate, $1b$ well-defined, connected with lower margin of cell by a bar near base, 2 and 3 from point of angle, transverse vein sometimes (*chalcophanes*) obsolete between 3 and 4, forked parting-vein well-defined, rising out of lower margin of cell near base, sometimes (*chalcophanes*) connected with upper margin by a bar near base, terminating in 4 and 5, between which transverse vein is absent, 7 and 8 stalked, 7 to hindmargin, secondary cell well-defined, 9 and 10 out of its upper margin, 11 from $\frac{1}{3}$ of cell, giving rise to an additional vein, and connected with 12 by a bar above (*chrysargyra*) or below (*chalcophanes*) the additional vein, 12 sometimes (*chalcophanes*) connected with upper margin of cell at base, giving rise to an additional vein above in middle, and sometimes (*chalcophanes*) a second near base. Hindwings rather narrower than forewings, ovate-lanceolate, cilia $\frac{3}{4}$; neuration identical with that of forewings, except as follows: $1b$ rising out of upper fork of $1a$, not connected with cell, 2 and 3 remote, transverse vein between 3 and 4 well-defined, the four main veins not connected at base of wing, 11 from middle of cell, 11 and 12 without additional branches.

Differs from the typical genus *Micropteryx* (which requires subdivision on the basis of neuration) by the stalking of veins 7 and 8 in both wings, and the additional branch of 11 in forewings.

I sent drawings of the neuration of this genus to Mr. R. McLachlan, the well-known neuropterist (whom I am glad to be able to quote as agreeing with me that there is a real and close developmental connection between this genus and the *Trichoptera*), with the request that he would express an opinion as to which genera of *Trichoptera* it approached most nearly. In reply he kindly furnished me with figures of several, with which it is practically almost identical. The nearest of these is *Rhyacophila* (*Rhyacophilidæ*); *Cyrnus* and *Holocentropus* (*Hydropsychidæ*) also approximate closely, and *Diplectrona* and *Hydropsyche*, in the same family, less nearly; *Calamoceras* (*Leptoceridæ*) is rather more remote. In the forewings of *Rhyacophila* the only important difference is the existence of an additional vein rising out of 4; but in the hindwings one observes with interest that this very difference has disappeared, this additional vein being absent; throughout these genera it seems that, in the tendency to a progressive simplification of structure, the hindwings took the lead, with the result that in the final established Lepidopterous type the hindwings have permanently four veins less than the forewings. *Rhyacophila* shows no other essential distinction from *Palæomicra*; the other

points of difference consist in the position (whether above or below the furcations) of the transverse bars, or their partial obsolescence. *Pal. chalcophanes* is especially interesting, as being at present the only Lepidopteron known which shows the basal trifurcation of vein $1a$ of the forewings, common to all the above-mentioned genera of *Trichoptera*; and the same species possesses the second (basal) branch of vein 12 of the forewings, which is shown in *Rhyacophila*, but not in any of the others mentioned, except *Hydropsyche*, which does not, however, show the other or median branch. I may add that this basal branch is perhaps rather to be regarded as a transverse bar connecting vein 12 with the costa, than as a true branch. It appears to me that the type of neuration of the *Trichoptera* consists of five simple veins, variously fused, towards the inner margin; and seven apically furcate veins, variously fused towards the base, and connected by a series of transverse bars.

27. *Pal. chalcophanes*, n. sp.

Male, female.—$10\frac{1}{2}$–11 mm. Head, palpi, and thorax ochreous. Antennæ pale ochreous, with about six very variable blackish bands. Abdomen grey. Legs pale ochreous, sharply banded with dark grey. Forewings oblong, costa abruptly bent near base, thence gently arched, apex acute, hindmargin straight, very oblique; light shining yellowish-ochreous, with hardly traceable somewhat darker coppery-shining oblique reticulating fasciæ, terminating in small dark purple-fuscous spots on margins; these spots are on costa near base, at $\frac{1}{3}$, $\frac{2}{3}$, $\frac{5}{6}$, and apex, on inner margin near base, at $\frac{1}{3}$, $\frac{2}{3}$, and anal angle, and on middle of hindmargin; third costal spot often double; cilia shining whitish-ochreous, on costal spots dark fuscous. Hindwings rather dark purple-grey; cilia grey.

Makatoku (Hawke's Bay), in March; nine specimens amongst deep forest.

28. *Pal. chrysargyra*, n. sp.

Male, female.—9–$10\frac{1}{2}$ mm. Head and thorax reddish-ochreous. Palpi light ochreous. Antennæ dark grey. Abdomen grey. Legs light ochreous. Forewings ovate-lanceolate, costa abruptly bent near base, thence moderately arched, apex acute, hindmargin very oblique, slightly sinuate; shining golden-ochreous; markings very indistinct, shining ochreous-whitish; a very irregular fascia before middle, a second at $\frac{2}{3}$, both often interrupted, and a series of several small spots along hindmargin and apical portion of costa; a dark fuscous dot in disc before middle, sometimes obsolete: cilia pale shining golden-ochreous. Hindwings purplish-grey; cilia whitish-grey.

Lake Wakatipu (1,100 feet), in December; taken commonly flying over flowery herbage by the side of a small rivulet.

GRACILARIADÆ.

I add a new genus and species to those already described.

13. CONOPOMORPHA, n. g.

Head smooth; no ocelli; tongue moderate. Antennæ 1½, in male filiform, simple, basal joint moderate, rather flattened. Labial palpi moderately long, curved, rough-scaled beneath throughout, second joint not reaching base of antennæ, terminal joint acute. Maxillary palpi rather long, slender, porrected. Posterior tibiæ thinly clothed with rough hairs above, tarsi twice tibiæ. Forewings very narrow, parallel-sided, round-pointed; 1 simple, 2 from near angle, 3 and 4 short-stalked from angle, 7 to costa, 9 and 10 from close together, 11 absent, upper margin of cell obsolete towards base. Hindwings half as broad as forewings, almost linear, cilia 5; transverse vein absent between 3 and 5, 4 absent, 5 and 6 as though from a point, 7 free.

29. *Con. cyanospila*, n. sp.

Male, female.—12–14 mm. Head ochreous-whitish, sometimes suffused with fuscous. Palpi whitish, second joint dark fuscous except apex, terminal joint with dark fuscous band and subapical ring. Antennæ grey. Thorax ochreous-whitish, mixed with dark fuscous. Abdomen grey. Legs dark fuscous, apex of joints and oblique bands of tibiæ whitish. Forewings dark fuscous, irregularly mixed with whitish-ochreous, tending to form small scattered cloudy spots or strigulæ; costa dotted with whitish, with three white strigulæ towards base, first two rather inwardly, third outwardly oblique, a suffused pair beyond middle, and three oblique pairs towards apex, first of these meeting a similar pair from inner margin, preceded in disc by a small white spot, and followed by a metallic-blue spot; two oblique whitish strigulæ from inner margin beyond middle, and sometimes one or two others beneath fold; a transverse metallic-blue ante-apical line; a small metallic-blue apical spot: cilia grey, round apex whitish, with dark fuscous lines. Hindwings dark fuscous; cilia grey.

Taranaki, Palmerston, Makatoku, and Masterton; common in February and March amongst dense forest. In repose the imago sits either with the fore-part raised as in *Gracilaria*, or closely appressed to surface, but with the four anterior legs laterally extended; the latter position is apparently most habitual, serving to conceal it on the tree-trunks on which it usually sits.

Art. XXXVI.—*Notes on Nomenclature of New Zealand* Geometrina.

By E. Meyrick, B.A.

[*Read before the Philosophical Institute of Canterbury, 1st October*, 1885.]

The publication of Scudder's "Nomenclator Zoologicus" has enabled me to ascertain that in adopting a certain class of generic names in the *Geometrina* I committed a great indiscretion, since these names appear to have been mostly already employed generically. I have, therefore, re-named those genera which had titles pre-occupied by others, reverting to my usual system. The following changes are made:—

Parysatis, Meyr., to be *Paradetis*, Meyr.
Panopæa, Meyr., to be *Pancyma*, Meyr.
Eurydice, Meyr., to be *Homodotis*, Meyr.
Harpalyce, Meyr., to be *Probolæa*, Meyr.
Stratonice, Meyr., to be *Arctesthes*, Meyr.
Thyone, Meyr., to be *Asaphodes*, Meyr.
Hermione, Meyr., to be *Aulopola*, Meyr.
Hippolyte, Meyr., to be *Epicyme*, Meyr.
Arsinoe, Meyr., to be *Anachloris*, Meyr.
Pasithea, Meyr., to be *Notoreas*, Meyr.
Statira, Meyr., to be *Stathmonyma*, Meyr.
Atossa, Meyr., to be *Epicasis*, Meyr.
Phyllodoce, Meyr., to be *Gonophylla*, Meyr.

For *Amastris*, Meyr., the name of *Sestra*, Walk., may be adopted.

The genus described as *Scotosia*, Stph., is (as I have pointed out elsewhere) not the true *Scotosia*, but is identical with *Cephalissa*, Meyr., with which it may be included, the points of distinction relied on being found insufficient.

Cacopsodos, Butl., is identical with *Dichromodes*, Gn., which latter name must be retained; the species will therefore be *Dichromodes nigra*.

Art. XXXVII.—*On the Spiders of New Zealand.*

By A. T. Urquhart.

[*Read before the Auckland Institute, 19th October*, 1885.]

Plates VI.–VIII.

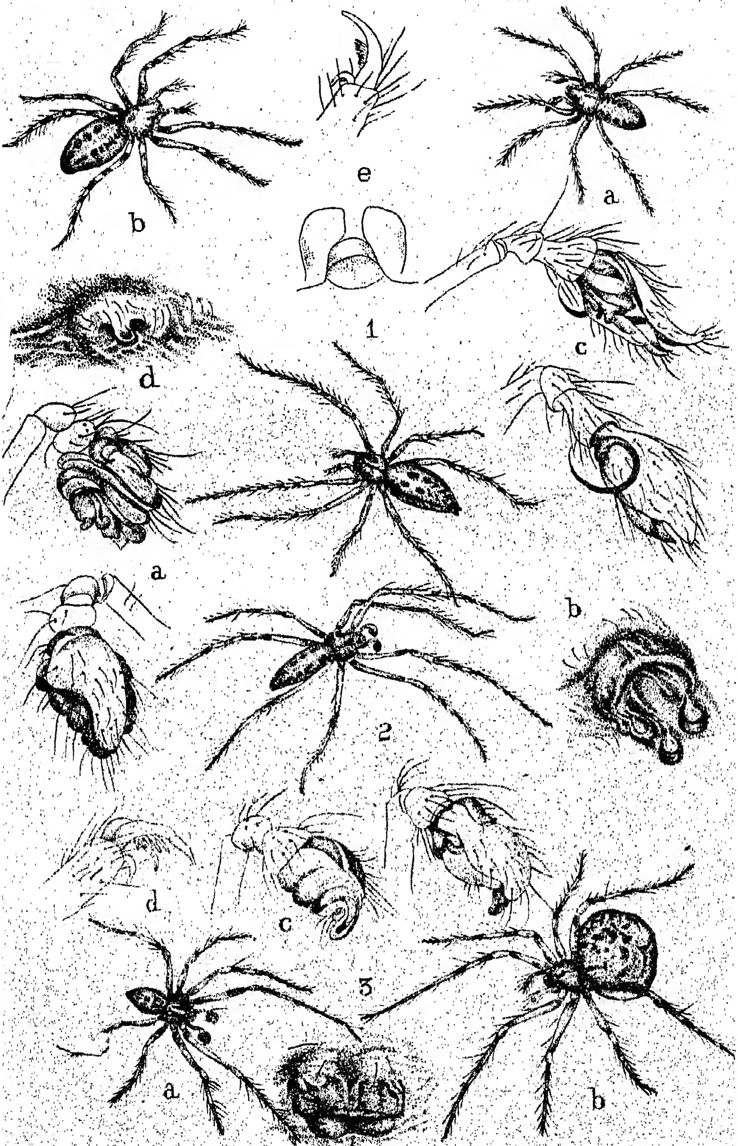
Fam. THERIDIIDÆ.

Genus **Linyphia**, Latr.

Linyphia diloris, sp. n. Pl. VI., fig. 1.

Length of an adult female 5 mm., and of an adult male 4 mm.

Cephalothorax oval; mahogany-brown, rugulose; lateral marginal constrictions at caput moderate; median indentation



A.T.U. del. NEW ZEALAND SPIDERS.

longitudinal; normal grooves moderate; profile line level, slightly curved at either end; *clypeus* vertical, in height rather more than half facial space.

Eyes on dark spots; four intermediate form a trapezoid longer than broad; anterior-centrals dark, close, much the smallest of eight; posterior pair rather less than their diameter apart, and more than twice that distance from posterior laterals next to them; hind-centrals and laterals, which are largest of the eight, and placed contiguously to each other on moderate tubercles, have a pearl-grey lustre; anterior row of eyes straight, posterior row slightly curved, convexity of curve directed backwards.

Legs moderately long, relative length 1, 4, 2, 3; i.–iv. nearly equal; yellowish-brown colour, faint olivaceous annulations; armature erect hairs, spine on tarsi of first pair, and spines on tarsi and metatarsi of hind pairs; superior tarsal claws, 1st pair, moderately strong, curving at free end; 13 close, short teeth, increasing in length, pointing backwards; inferior claw smaller than superior, bent, point directed forwards, two short close teeth pointing forwards, basal tooth shortest.

Palpi resemble legs in colour; palpal claw fine, straight, two short teeth near base, pointing forwards.

Falces vertical, prominent at base, divergent, mahogany-brown; four sharp teeth outer row, two central long.

Maxillæ somewhat roundly truncated on outer side, tapering at extremity, inclined towards *lip*, which is about as broad as long, prominently recurved.

Sternum cordate, pitted. These parts have a dark mahogany hue.

Abdomen oval, projects over base of cephalothorax; light-brown, small creamy spots; two blackish undulating bands extend along the dorsal surface, converging towards each other at anterior and posterior ends; sides and ventral surfaces light brown, fine hairs. *Vulva* yellowish-brown, semicircular, transversely wrinkled eminence, concave within; talica on posterior side looped up; projecting from above is a ladle-like apophysis; translucent yellow, reddish extremity.

The *male* resembles the female in form, colour, and markings, but is rather slimmer and shorter. *Palpi* have tints of legs; humeral joint long; cubital short; radial cup-shaped; digital oviform, tapering at extremity; convex and hairy externally; concave within, comprising palpal organs, which are complex, most noticeable on outer side, two short apophyses directed downwards; projecting at apex is a semi-transparent, concave, pointed, greenish membrane; springing from the inner side, near the articulation at the two joints, is a remarkably long, slender, curved dark process.

This species is common in damp spots beneath open manuka, under long grass, etc; spins a fine horizontal web across hollows. Pairs in October–November.

Te Karaka, Auckland, *A.T.U.*

Linyphia trisphathulata, sp. n. Pl. VI., fig. 2.

Length of an adult female 3 mm., and of an adult male 3 mm.

Cephalothorax oval, moderately constricted at caput; rugulose, glossy, yellowish, or light greenish-brown; lateral margins and wide median band dark olive-green; median indentation somewhat lozenge-shaped, apex directed posteriorly; normal grooves rather faint; *clypeus* slightly concave, projects forwards; equals half depth of facial space.

Eyes disposed in two slightly arched transverse rows, forming a narrow oval space; four centrals form a trapezoid, longer than broad; anterior pair close, darkest and much the smallest of eight; hind-centrals largest of eight, placed on black oval tubercular eminences, rather more than their diameter from each other, and the hind-laterals next to them; lateral eyes seated obliquely on rather strong black tubercles, more than their diameter apart, and less than that space from the fore-centrals.

Legs slender, long; relative length 1, 4, 2, 3; i., ii., iv. nearly equal; colour of cephalothorax; tibiæ and metatarsi have olivaceous annulations; armature few dark hairs and slender spines; superior tarsal claws, 1st pair, rather weak, slightly curved, about 10 short, close teeth, increasing in length; inferior claw smaller than superior, bent, one tooth, point behind.

Palpi have tints and armature of legs; palpal claw weak, straight, apparently no teeth.

Falces vertical, slightly divergent; pale-amber; three teeth outer row, inner small points.

Maxillæ nearly twice as long as broad, obliquely truncated on outer side, inclined towards *lip*, which is about as broad as long, everted, dark hue.

Sternum broad cordate, blackish-brown, pitted.

Abdomen ovoid, pointed posteriorly, projects forwards; petiolum rather long; yellowish or brownish mottled with a lighter tint; two irregular (in some examples partially composed of spots) dark-chocolate bands converge from base towards spinners; at posterior end are a series of dark angular lines whose vertices are directed forwards. *Vulva* somewhat circular, prominent, membranous, rugose, brownish eminence, concave within; tibia on posterior side produced into clear pale-amber coloured ladle-shaped apophyses with reddish margins, projecting from between the latter is a similar but longer apophysis.

Male does not differ essentially from female, legs rather longer, and abdomen slimmer; specific pattern in some examples

consists of a double row of spots. *Palpi* pale yellow; humeral joint long, cubital and radial short, latter cup-shaped, few dark strong hairs; digital joint large, ovoid, convex, and moderately hairy externally; palpal organs complex, series of flattish lobes projecting forwards; on upper side, close to articulation of digital and radial joints, is a remarkable dark-red crescent-shaped process. Projecting forwards on the lower side is a pale greenish membrane, margins dark, rounded, serrated.

Taken amongst low vegetation; forms a fine open horizontal web across hollows in shady places. Commences pairing about November.

Te Karaka, Auckland, *A.T.U.*

Genus **Theridium**, Walck.

Theridium varium, sp. n. Pl. VI., fig. 3.

Length of an adult female 7 mm., and of an adult male $4\frac{1}{2}$ mm.

Cephalothorax broad oval, moderately constricted in front; yellowish-brown, suffused about margins and furrows with dark brown; median fovea somewhat oval, deep; radial and caput striæ moderate; profile contour low arch; *clypeus* slightly prominent, in height more than half facial space.

Eye disposed in two transverse curved rows, forming a narrow oval space; four centrals form a quadrilateral figure rather longer than broad; hind-centrals rather more than their diameter apart, and a diameter and a half from the hind-laterals; fore-centrals dark, seated on brown tubercular prominences; laterals close, placed obliquely on moderate tubercles; these eyes and hind-centrals have a pearly lustre.

Legs long, moderately slender; 1, 4, 2, 3 = 16, 13, 11, 8 mm.; clear light-brown, annulated; armature strong dark hairs and bristles; superior tarsal claws, 1st pair, moderately strong and curved, free, and more than half claw, tip bent; 6 teeth, 5 basal rather strong comb-teeth, increasing in length; outer strongest and longest, curved backwards; inferior claw smaller than superior, sharply bent, one curved tooth.

Palpi colour and armature of legs; palpal claw short, sharply curved, 7 long open comb-teeth, forming an even line with point of claw.

Falces conical, slender, nearly vertical, yellowish-brown, few sharp teeth.

Maxillæ long, obliquely truncated on outer side, yellowish-brown, inclined towards *lip*, which is twice as broad as long.

Abdomen large, very convex above, projects over base at cephalothorax; pointed at spinners; ground colour light-brown, spotted and blotched with dark greenish-brown, few light streaks; median band irregular, somewhat leaf-like, between it and spinners are a few angular marks, apices directed forwards;

lateral margins dark oblique streaks; branchial opercula orange-red. *Genital* organ large, concave within; anterior membrane or labrum forms a narrow transversely wrinkled hood, centrally produced into a tapering process, directed backwards; labium large, dark, everted.

Male much smaller than female, less distinctly marked, tints darker. Actual and relative length of *legs* differ from females, 1, 2, 4, 3 = 14, 11, 9, 7 mm.

Palpi furnished with black hairs, have the bright-reddish hue of legs, with exception of radial and digital joints, which have a blackish-brown tint; humeral joint long, cubital and radial short, latter cup-shaped; digital joint oval, convex, and hairy externally, convexities directed towards each other; concave within, palpal organs simple lobes, terminating with a broad, concave, curved greenish membranous process, with dark margins.

(α) *Cephalothorax* light yellow-brown, faintly suffused with dark tint. *Legs* shade lighter than cephalothorax, annuli moderately marked. *Abdomen* dull, pale yellow-brown, spotted and marked with dark-brown, specific pattern more or less obliterated. *Male* has more or less light tints of female.

(β) *Cephalothorax* glossy brown-black. *Legs* clear light-brown, or greenish-brown, annulations dark. Pattern on *abdomen* resembles type form, but darker. Male has the characteristic dark coloration of the variety.

(γ) Marks on *abdomen* black, resemble type form, ground colour slaty-grey, mottled with creamy-white.

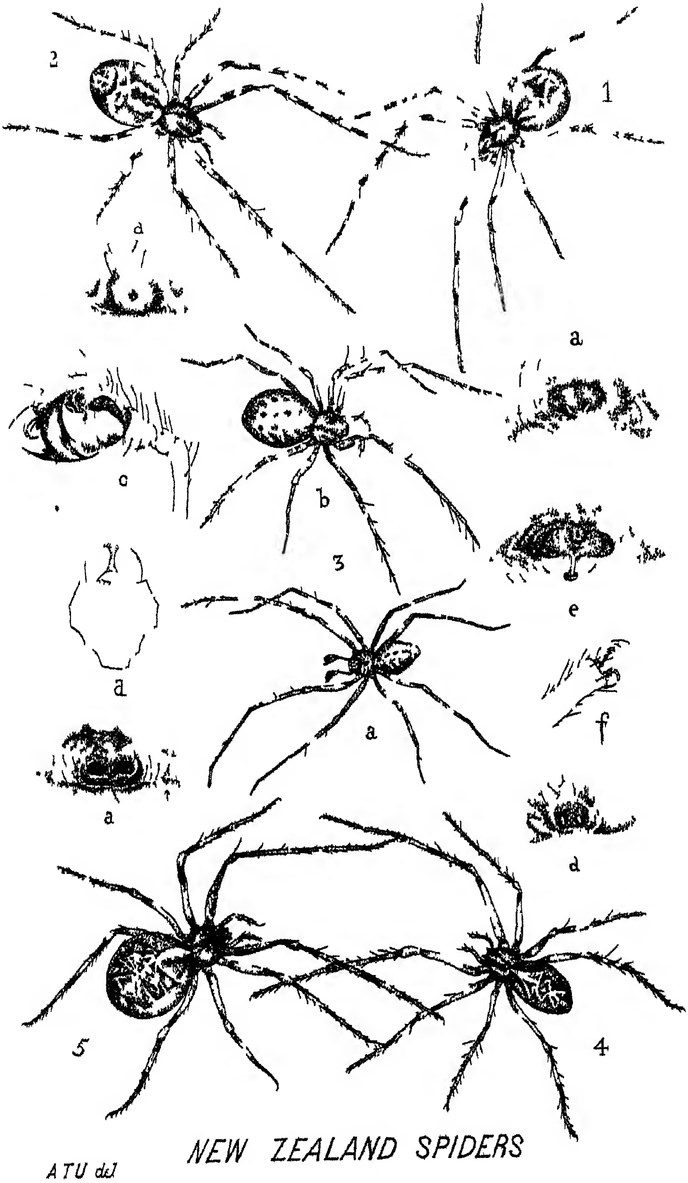
This species is common about buildings, and is to be met with on shrubs. Commences pairing about October; young rarely hatched before November. Cocoons are fabricated throughout the summer until the end of May, when mature examples—as is generally the case with species of this family—become scarce during the winter months. The female usually constructs from 2 to 4 pea-shaped cocoons about 10 mm. in depth, composed of light-brown silk, of a soft felty texture, containing from 60–350 unagglutinated spherical straw-coloured eggs. The web is of normal form—viz., a series of lines intersecting one another in different planes, and at various angles.

Te Karaka, Auckland, *A.T.U.*

Theridium veruculatum, sp. n. Pl. VII., fig 1.

Length of a mature female 4–4½ mm., and of an adult male 3 mm.

Cephalothorax oval, moderately constricted in front; glossy, yellowish-brown colour, suffused with a darker hue; caput convex, well-defined; indentation below eyes; thoracic fovea large, somewhat circular; radial striæ moderate; contour of profile arched; *clypeus* prominent, in height about equal to depth of ocular area.



NEW ZEALAND SPIDERS

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Four central *eyes* nearly form a square; fore-pair furthest apart, dark, placed on prominent tubercles, hind-pair less than their diameter apart; laterals contiguous, seated obliquely on moderate tubercles; hind-laterals more than their diameter from posterior median eyes; fore-laterals close to anterior-centrals; side and hind intermediate eyes have a pearl-grey lustre.

Legs slender, relative length 1, 4, 2, 3 = 9, 7, 6, 4½ mm.; clear pale-brown, dark annuli, furnished with black hairs and fine erect bristles; superior tarsal claws, 1st pair, moderately strong and curved, seven comb-teeth pointing forwards, increasing greatly in length and strength, apical teeth have form of free end of claw, and are directed outwards; inferior claw smaller than superior, sharply bent, free and long and fine, one strong tooth, point behind.

Palpi slender, clear pale-brown, terminal joints reddish-brown, digital joint furnished with strong black hairs; palpal claw has seven teeth, increasing in length, directed forwards.

Falces slender, vertical, brownish-amber colour.

Maxillæ long, linear, obliquely truncated on outer side, yellowish, inclined towards *lip*, which is broader than long, obtuse, dark.

Sternum cordate, brownish.

Abdomen broad-oval, slightly cleft at base, very convex above, pointed at spinners; clothed with nearly erect light hairs, ground colour brownish, mottled and marked with various tints of brown, buff, and purple; a purple and brown lance-like mark with buff margins extends more than half across median line, on lateral margins are a series of oblique marks; ventral surface brownish-yellow, fine hairs. Between branchial opercula extends a transverse greenish-brown eminence, semicircular on anterior side, in centre of eminence is a somewhat circular depression—the genital organ; labia on posterior side terminate in two dark, conical processes directed outwards.

The *male* is only 3 mm. in length, does not differ essentially in colouration or markings from female; *cephalothorax* more elongated; *abdomen* slimmer, petiolum exposed. Only marked difference in *legs*, little shorter. *Palpi* moderately long and slender, straw-coloured, except two apical joints which have an amber hue. Humeral joint long; cubital and radial short, about equal in length, furnished with bristles, latter joint cup-shaped; digital joint oviform, convex, and sparsely haired externally, convexities directed towards each other; palpal organs simple, form a glossy, rugose lobe, partially truncated, with slight dark indentation at about two-thirds of its length, tapering and roundly pointed at apex; connected with darkish indentation, and projecting slightly forwards, is a reddish margined membrane.

(*a.*)—Dull light brownish-umber, bright colours absent, specific marks brownish.

This species spins a web of normal form about buildings, on trees, etc.; fabricates its first cocoons in November, they have a broad-oval form, 3 mm. in diameter, greenish-brown, of a soft felty texture, suspended by fine lines, contain about 128 unagglutinated, spherical, straw-coloured eggs. Pairs about end of October.

Te Karaka, Auckland, *A.T.U.* Common in the district.

Theridium blatteus, sp. n. Plate VII., fig. 2.

Length of a mature female, $2\frac{1}{2}$ mm.

Cephalothorax broad-oval, moderately constricted at caput, which is prominent; median indentation transverse oval; it is glossy, greenish-yellow, suffused with dark olive; profile line rises abruptly from thoracic junction, dips into indentation, then forms a moderate arch across caput. *Clypeus* prominent, slopes forward, about half facial space.

Four central *eyes* form a square, anterior pair prominent, dark, and rather smaller than the rest, which are flatter, have a pearly lustre, and placed on lake-coloured eminences; hind-centrals are about as far from each other as they are from the hind-laterals next to them—a space equal to their diameter; laterals nearly contiguous, seated obliquely on small tubercles, fore-pair close to anterior-centrals.

Legs long, slender, 1, 4, 2, 3; clear yellowish-brown, black annulations; armature fine erect hairs, long bristles; superior tarsal claws, 1st pair, rather weak and straight, tip bent, seven comb-teeth increasing in length and strength; interior claw smaller than superior, moderately bent, one pointed tooth.

Palpi moderately long, resemble legs in colour and armature; palpal claw short, curved, 4 long comb-teeth, forming an even line with point of claw.

Falces vertical, slender, yellowish, suffused with dark-olive, fangs short.

Maxillæ broad, somewhat rounded on inner, and obliquely truncated on outer side, moderately inclined towards *labium*, which is rather broader than long, somewhat pointed.

Sternum broad-cordate; these parts are dark-brown.

Abdomen oviform, broad, pointed at spinners, projects over base of cephalothorax, very convex above; ground-colour pale-purple and yellowish tints, thickly marked with small purple spots; wide central and transverse black bands, margined with pale-yellow at their extremities, form a large cross-like figure; ventral surface black, few yellow spots, spinners short. *Vulva* prominent brownish circular eminence, orifice large.

Te Karaka, Auckland, *A.T.U.*

Theridium pumilio, sp. n. Plate VII., fig. 3.

Length of an adult female, $1\frac{3}{4}$–2 mm., and of an adult male, $1\frac{1}{4}$ mm.

Cephalothorax broad-oval; lateral marginal constrictions at caput moderate; clear pale stone-colour, rugæ scale-like; median band and lateral margins dark-olive; median indentation broad shield-shaped; contour of profile slight double arch; *clypeus* prominent, less than half facial space.

Four intermediate *eyes* are placed on oval black spots, and form a trapezoid longer than broad, whose shortest side is in front; fore-centrals dark, smallest of eight; space between hind-centrals—which, with side eyes, have a pearly lustre—is less than an eye's diameter, and the interval between each and the hind-lateral next to it more than an eye's breadth; laterals contiguous, seated obliquely on dark tubercular prominences, nearly their diameter from fore-centrals.

Legs long, slender, 1, 2, 4, 3; more transparent than cephalothorax; armature few dark hairs and strong erect bristles; superior tarsal claws, 1st pair, slightly curved from base, straightening at free end, tips bent; about 7 comb-teeth, increasing in length and strength; inferior claw smaller than superior, bent sharply downwards and outwards, apparently only one tooth.

Palpi long, slender, resemble legs in colour and armature; palpal claw like tarsal claw, 5 teeth.

Falces vertical, divergent, normal clear hue; double row of teeth, 3 outer strong.

Maxillæ somewhat oviform, apices and inner margins fringed with black hairs, inclined towards *labium*, which is broader than long, prominently everted, dark hue, pale apex.

Sternum broad-cordate, normal hue.

Abdomen oviform, convex above, yellowish, more or less mottled with various shades of reddish-brown—in some examples faint; three longitudinal olivaceous spotted lines converge from base to spinners; lateral margins and ventral surface marked with streaks of similar colour; in some examples dark marks on cephalothorax and abdomen nearly absent, and buff patch at posterior end of abdomen prominent. *Vulva* large, somewhat coniform, concave within, exterior rugose membrane has tints of tortoise-shell, with a pale median band terminating at margin in a pale amber-coloured spoon-shaped, short apophysis, directed backwards; orifice large, somewhat reniform; projecting from posterior margin of labia is a second spoon-shaped apophysis, longer and larger.

Male nearly equals female in length, *cephalothorax* broader, striæ more defined, lateral margins have pinkish eminences over each coxal joint. *Palpi* yellowish, humeral joint long, cubital and radial short, latter cup-shaped; digital joint broad-oviform, convex and hairy externally, convexities directed towards each other; palpal organs simple, series of reddish lobes, projecting beyond them on lower side is a pointed black process.

Abdomen somewhat diamond-shaped, yellowish, mottled with orange-red, buff patch at posterior end; series of olivaceous spots form median band; streaks and marks on lateral margins and ventral surface.

Mature examples, especially females, may generally be taken throughout the winter months. Until winter rains set in, these little spiders are often numerous about pastures and amongst low native vegetation in damp spots. They spin a fine horizontal web, with a small triangular mesh; one portion is drawn up to a stem or blade, beneath which the spider rests.

Te Karaka, Auckland, *A.T.U.*

Theridium calyciferum, sp. n. Pl. VII., fig. 4.

Length of an adult female, 4 mm.

Cephalothorax broad-oval, lateral marginal constrictions at caput moderate; rugulose, brownish-yellow; caput, median band and marginal zone brown; fovea large, somewhat oval; radial and caput striæ well-defined; contour of profile rises from thoracic junction at an angle of 45°, notched at median indentation, caput slightly arched; *clypeus* convex, in height rather less than half facial space.

Eyes about equal in size, seated on black spots; four centrals nearly form square, anterior pair furthest apart, dark; hind-pair are one eye's breadth from each other, and rather more than that space from fore-centrals; laterals nearly contiguous, placed obliquely on tubercles; more than their diameter from hind-centrals.

Legs long, slender, relative length, 1, 4, 2, 3 = 10, 7, 6, 5 mm.; yellowish, dark annuli at articulation of joints, except tarsal; femora spotted; armature hairs and numerous strong bristles, tarsi of hind pair furnished with, on under side, strong curved hairs; superior tarsal claws, 1st pair, moderately curved, tip bent, 7 teeth increasing in length and strength, 3 apical teeth, strong, in form resemble free end of claw, directed outwards; inferior claw smaller than superior, bent downwards, 1 tooth, point behind.

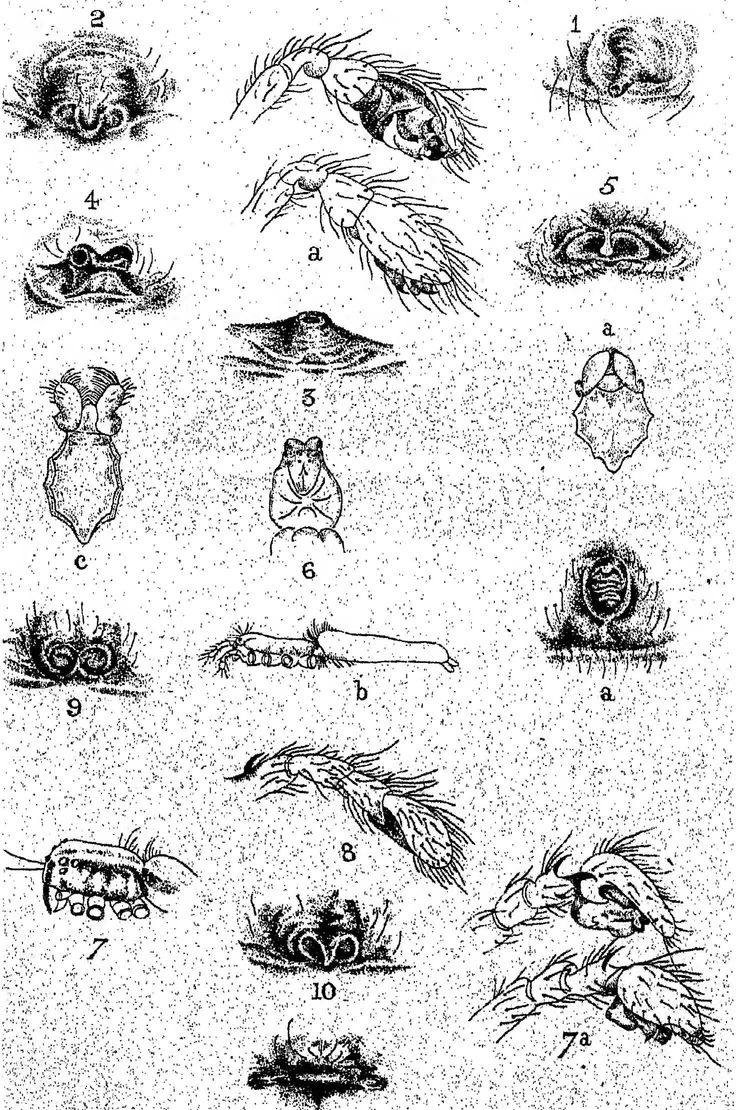
Palpi colour and armature of legs, palpal claw resembles tarsal claw, 6 teeth.

Falces convex, brownish-yellow, project a little forwards, one socket tooth.

Maxillæ somewhat spathulate, yellowish, inclined towards *labium*, which is broad, everted, nearly half length of maxillæ, greenish tinge.

Sternum heart-shaped, yellowish, margined and spotted with chocolate.

Abdomen elongate-oval, dorsal surface covered by a brown ovoid, leaf-like mark, median band strongly dentated, tapering



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NEW ZEALAND SPIDERS.

posteriorly, creamy color, brown marks; ventral surface light-brown. *Vulva* moderately prominent, circular, concave within, on posterior side are two black cone-like processes, apices directed backwards. Branchial opercula resemble yellowish cup-shaped calyces, acute apices directed towards genital organ.

Te Karaka, Auckland, *A.T.U.*

Theridium cruciferum, sp. n. Plate VII., fig. 5.

Length of an adult female 5 mm., of an adult male 4 mm.

Cephalothorax broad oval, slightly compressed before, glossy, light-brown; median band and marginal zone dark-brown; median indentation circular, striæ moderate; profile line rises from thoracic junction at an angle of 20°, then slopes across caput. *Clypeus* moderately prominent, in height about two-thirds depth of ocular area.

Eyes on dark spots, four central nearly form a square, anterior pair dark, seated on prominences; posterior pair rather more than their diameter apart, and closer to each other than each is to the hind-lateral next to it; laterals placed on tubercles, nearly contiguous.

Legs long, slender, 1, 4, 2, 3; first pair dark, ii., iii., iv., yellowish, speckled as far as tarsi, brown annuli at articulation of joints; furnished with few hairs and erect bristles; superior tarsal claws, 1st pair, 8 comb-teeth increasing in length and strength; inferior claw nearly equals superior in strength, 1 strong tooth.

Palpi pale yellow, slender, armature of legs; palpal claw 6 teeth, increasing in length and strength.

Falces conical, nearly vertical, chocolate-brown, few teeth.

Maxillæ long, somewhat roundly truncated on outer side, inclined towards *labium*, which is broader than long, rounded; these parts have a greenish-yellow tinge.

Sternum broad cordate, rugulose, stained round margins and spotted with purple-brown.

Abdomen oviform, convex, pointed at spinners; ground-colour olive-brown; on dorsal surface there is a large brownish-black, nearly ovate, indented leaf-like mark; on the fore part there is in some examples a well-defined cross, the base of which is creamy-white, margined with black, and directed forwards; remaining portions purple, picked out with whitish lines; between cross and spinners are several creamy spots throwing off oblique purple lines; lateral margins have several creamy, purple-spotted bands, and oblique dark bars; round spinners, and on ventral surface, are creamy purple-spotted marks. *Vulva* yellowish-brown, transversely wrinkled, oval eminence, concave within; projecting from anterior side, directed backwards, is a short tapering process, labia form; on posterior side, a dark, tumid, projecting lip, partially cleft in centre.

Male rather shorter than female, *cephalothorax* and *abdomen* more elongated, does not differ essentially in coloration or markings. *Legs* resemble female in colour and armature, but differ in their relative and actual length, 1, 4–2, 3, =13, 7½, 5 mm. *Palpi* rather long. slender, clear yellow-brown, sparsely furnished with coarse black hairs; humeral joint long, cubital and radial short, do not differ much in size, slender, cup-shaped; projecting from superior surface of former, are two strong, long bristles; digital joint oval, rugulose, mahogany colour; convex and hairy externally, convexities directed towards each other; concave beneath; palpal organs moderately complex; viewed from beneath, concavity at base is covered, for about one-fourth of length of joint, by a wide membranous band, little beyond transverse band, projecting forwards from margins of concavity are two short and stout apophyses; between these is a shield-shaped eminence, produced at its fore extremity into short, dark, horn-like processes.

Species common, frequents manuka; examples, male and female, differ greatly both in shades of coloration and distinctness of specific pattern; in yellowish or brownish-creamy specimens the cross-like figure is more or less obliterated, and devoid of lake markings. Pairs about November.

Auckland, *A.T.U.*

Theridium triloris, sp. n. Pl. VIII., fig. 1.

Length of an adult female 5 mm., and of an adult male 4 mm.

Cephalothorax oval, bright mahogany-brown; lateral marginal constrictions at caput moderate; median indentation, which is somewhat circular, and radial striæ well marked; profile rises with a slight arch to occiput, forepart of which is prominent; *clypeus* moderately prominent, in height equals half facial space.

Eyes form two transverse curved rows, convexity of curves directed forwards, hind-curve slight; eyes placed on dark spots; four intermediate form a quadrilateral figure, longer than broad; anterior centrals darkest and rather smallest of eight; interval between hind pair equals their diameter; laterals, which are seated obliquely on dark tubercles, one quarter of their breadth apart, are rather further from hind-centrals than the latter are from each other.

Legs rather short, relative length 1, 4, 2, 3; yellow-brown, dark greenish annuli at articulations; armature erect hairs, few bristles; superior tarsal claws, 1st pair, moderately strong, curved, 9 comb-teeth increasing in length and strength; inferior claw rather stout, bent, 2 close teeth, basal small.

Palpi resemble legs in colour and armature; palpal claw strong, curved, 7 comb-teeth directed forwards, forming an even line with point of claw.

Falces prominent at base, vertical; light red-mahogany colour; one strong tooth near extremity.

Maxillæ obliquely truncated on outer side, inclined towards *labium*, which is somewhat oval, more than half length of maxillæ, everted; these parts have a brownish tint, labium darkest.

Sternum broad cordate, rugulose, chocolate-brown.

Abdomen oval, moderately convex above, projects over base of cephalothorax; brownish-black, sparingly clothed with fine light hairs; encircled and centrally divided with creamy-coloured disjointed bands; marginal bands extend from spinners along ventral surface to branchial opercula. *Genital* organ vermiform, pendulous, directed backwards; pale amber-colour, extremity reddish; projects from much wrinkled integument of a darker hue.

Male shorter and slimmer than female, resembles her in specific pattern, colour, and armature; caput rises higher, projects further forwards, causing hind and especially the fore-row of *eyes* to form a stronger curve.

Legs rather longer than female's, i.–iv., ii.–iii., nearly equal, strong black hairs.

Palpi mahogany-colour; humeral joint long; cubital and radial short, latter cup-shaped, greenish; digital joint oval, convex, and hairy externally, convexities directed towards each other; palpal organs moderately complex, lobe-like, posterior half dark; projecting at extremity is a broad black, concave, sharply pointed process.

Taken on shrubs; cocoons two or more, whitish, globular, 4 mm. in diameter, suspended by a short silken line to inferior surface of leaf; about 15 light-coloured spherical eggs, not agglutinated together; web normal intricate lines. Pairs in November.

Te Karaka, Auckland, *A.T.U.*

Theridium squalide, sp. n. Plate VIII., fig. 2.

Length of an adult female, 5 mm.

Cephalothorax oval, moderately compressed at caput, glossy red-mahogany; median fovea narrow-oval, deep, nearly length of thorax; caput and radial striæ well-marked; contour of profile rises gradually from thoracic junction, forming a slight arch across caput; *clypeus* vertical, convex, indentation below eyes; height equals depth of ocular area.

Four central *eyes* form a trapezoid whose shortest side is between anterior pair, which are smallest of eight; posterior pair less than their diameter apart, rather more than their breadth from hind-laterals; posterior centrals and side eyes have a pearl-grey lustre, latter largest of eight, close, placed obliquely on moderate tubercles.

Legs moderately long and slender; 4, 1, 2, 3, iv. pair slightly exceeds i. in length; colour yellowish-amber; armature erect black hairs, few fine bristles; superior tarsal claws, 1st pair, moderately strong and curved, 7 rather short close teeth, increasing in length; inferior claw smaller than superior, bent downwards and forwards, two teeth, basal shortest and stoutest.

Palpi rather long and slender, resemble legs in colour and armature, strong hairs on digital joint; palpal claw rather weak, 5 or 6 short teeth.

Falces prominent at base, vertical, divergent, rugulose, bright red-mahogany, 3 strong teeth.

Maxillæ long, linear, somewhat rounded, with lip-like indentation at apex (apparently caused through pressure of fangs), inclined towards *labium*, which is broader than long, everted; these parts have a bright red-mahogany colour.

Sternum cordate, pitted, dull mahogany-colour.

Abdomen ovoid, yellowish-brown, clothed with light hairs. *Vulva* yellowish brown, transversely wrinkled, somewhat oblong, convex eminence, concave within, projecting posteriorly from anterior side there is a yellowish amber-coloured protuberant lip, with incurved margins.

Te Karaka, Auckland, *A.T.U.*

Theridium setiger, sp. n. Plate VIII., fig. 3.

Length of a mature female, 3 mm.

Cephalothorax oval, moderately constricted forwards, caput prominent in front; rugulose, glossy brown-black; median indentation semicircular, convexity directed backwards; normal grooves moderate; profile contour forms a slight arch across caput, roundly curved posteriorly; *clypeus* projects prominently forwards, pointed; indentation below eyes, in height nearly equals depth of ocular area.

Eyes large, four centrals form a square; anterior pair dark, placed somewhat obliquely on angular projections; posterior row, rather less than their diameter apart, form a slight curve, convexity of curve directed backwards; lateral eyes, which have the pearly lustre of hind-centrals, are contiguous, and seated obliquely on reddish-brown tubercles, space between them and fore-centrals rather less than interval between latter pair.

Legs moderately long and strong, relative length, 1, 4, 2, 3; i. longest, ii. nearly equals iv.; pellucid-grey, well-defined black-brown annulations; armature strong hairs, few bristles. Superior tarsal claws, 1st pair, moderately curved, 7 comb-teeth, increasing in length and strength; inferior claw fine, bent, apparently no teeth.

Palpi resemble legs in colour and armature, palpal claw strong, curved, 5 long comb-teeth forming an even line with point of claw.

Falces tapering, project slightly forwards, reddish-brown.

Maxillæ acute oval, inclined towards *lip*, which is nearly twice as broad as long; everted, one-third length of maxillæ.

Sternum broad cordate; these parts are chocolate-brown, rugulose.

Abdomen broad oval, strongly convex above, rises somewhat abruptly from thoracic junction; sparingly clothed with strong erect hairs and bristles; ground colour greenish-brown, slightly suffused with dull-pink, mottled with brown-black; median band faint, tapers towards spinners, black marks at base; on lateral margins are four oblique brown-black bars, streaked on posterior side with pink, converge towards spinners, which are short. *Vulva* somewhat conical, reddish-black, prominent eminence, orifice circular, large.

Te Karaka, Auckland, *A.T.U.*

Theridium zantholabio, sp. n. Plate VIII., fig. 4.

Length of an adult female, 4 mm.

Cephalothorax broad oval, constricted anteriorly; light amber-colour; median band brown, lateral margins faintly mottled with a similar hue; median indentation broad, U-shaped, large, moderately depressed; contour of profile rises at an angle of 40°, then slopes slightly to ocular area; *clypeus* prominent, in height about half facial space.

Four intermediate *eyes* form square, anterior pair dark; posterior pair less than their diameter apart, about that space from side-eyes, which are smallest of eight, contiguous, placed obliquely on small tubercles.

Legs moderately long and slender, relative length 1, 4, 2, 3; have hue of cephalothorax, rather faint brown annulations; armature dark hairs and erect bristles; superior tarsal claws, 1st pair, curved, 5 long comb-teeth; inferior claw moderately strong, free and fine, bent, 1 tooth, small point behind.

Palpi resemble legs in colour and armature, palpal claw curved, 7 long comb-teeth, forming an even line with point of claw.

Falces project slightly forwards, moderately slender, dark amber-colour, about 3 blunt teeth.

Maxillæ long, linear, roundly truncated on outer side, moderately inclined towards *labium*, which is nearly twice as long as broad, somewhat pointed; these parts have a reddish-amber hue, suffused with brown.

Sternum cordate, yellowish, margined with chocolate.

Abdomen oviform, convex above, yellowish-brown, suffused with dull pink; a broad, somewhat spathulate, irregularly pinnatifid median band, dark brown at basal end, lighter and spotted at truncated apex, extends two-thirds across the abdomen; lateral margins spotted and streaked; transverse

dark bands on ventral surface. Anterior portion of *vulva* consists of a reddish-black oblong, transverse, tapering eminence, circular fovea at either end, projecting upwards; on posterior side is a large, broad, clear yellow incurved lip.

Web consists of irregular lines; cocoons ovoid, yellowish-brown, undulations shaded with brown, loose felty texture; contain about 40 pale straw-coloured spherical eggs, not agglutinated together, but wrapped in a second delicate soft silky cocoon.

Taken in March; Cliffs, North Shore, Auckland, *A.T.U.*

Theridium sericum, sp. n. Pl. VIII., fig. 5.

Length of a mature female 9 mm., and of immature male 5 mm.

Cephalothorax broad-oval, glossy, yellowish-brown, moderately constricted in front; median fovea circular, radial and caput striæ moderately marked; contour of profile rises at an angle of 45° from thoracic junction to verge of median indentation, then slopes across caput. *Clypeus* convex, prominent, in height more than half facial space.

Eyes disposed in two transverse curved rows, forming a narrow oval space; four intermediate eyes nearly form a square; anterior pair darkest and rather smallest of eight; posterior pair rather less than their diameter apart, and more than that interval between them and lateral eyes next to them; side eyes contiguous, placed obliquely on small black tubercles, have the pearly lustre of hind-centrals.

Legs moderately long and strong, 1, 4, 2, 3 = 18, 15, 14, 10 mm.; reddish-brown; armature fine dark hairs and slender bristles; superior tarsal claws, 1st pair, moderately curved, free and thickening a little, tip bent inwards, 7 comb-teeth rapidly increasing in length and strength, strong teeth have somewhat the form of free end, directed forwards; inferior claw sharply bent, 2 teeth differing in size, close together.

Palpi resemble legs in colour and armature, palpal claw resembles superior tarsal claw, 7 teeth.

Falces convex, tapering, directed moderately forwards, few teeth, bright light-mahogany colour.

Maxillæ long, pointed, much inclined towards labium, which is somewhat oval, apex truncated, less than half length of maxillæ; these organs have a reddish-brown hue, apices light.

Sternum broad cordate, yellowish-brown, few dark hairs.

Abdomen oviform, convex above; chocolate-colour, series of four or five creamy-brown angular bars on dorsal surface, few fine dark hairs, abdomen has a soft silky lustre. *Vulva* on anterior side forms a low wrinkled, membranous arched hood, centrally produced into a yellowish spathulate process, directed backwards; moderately concave within, yellowish; oblong olivaceous mark in centre.

Male smaller than female, resembles her in form, markings, and colour. *Legs*, relative length, 1, 4, 2, 3 = 11, 9, 8½, 7 mm.

Some examples of this species are of a very dark brown-chocolate colour, specific pattern faint. These spiders are not uncommon in buildings, and under bags; mature examples may be taken throughout the winter months. Their webs are formed of fine lines, with a silky lustre, intersecting one another in various planes and at different angles. Cocoons are fabricated from about December to May, resemble loose balls, 10 mm. in diameter, of soft white wool; are suspended by a few short lines, generally close to the walls or roof, visible within are about 88–120 whitish spherical eggs, not agglutinated together.

Te Karaka, Auckland, *A.T.U.*

Fam. THOMISIDÆ.

Sub.-Fam. PHILODROMINÆ.

Genus **Hemiclæa**, Thorell.

Hemiclæa plautus,* sp. n. Plate VIII., fig. 6.

Length of an adult female, 13–15 mm.

Cephalothorax oval, very depressed, one-fourth longer than broad, moderately constricted forwards; mahogany-colour, glossy, rugose; sparsely clothed with light-yellowish pubescence, few interspersed fine plumose hairs, and erect black hairs, mostly about lateral margins. Caput relatively wide, squarely truncated, three depressions on median line, two anterior foveæ circular; basal depression forms with thoracic indentation a fiddle-like mark; caput and radial striæ distinct. Contour of profile level. *Clypeus* projects sensibly forwards, in height less than diameter of a fore-central eye.

Eyes small; posterior row slightly curved, convexity of curve directed forwards; median eyes smallest of eight, flat, and rather closer to one another than each is to the lateral eye next to it; anterior row shortest, straight; intermediate eyes, which are largest of eight, rather more than their radius apart, and about twice that interval from fore-laterals, form with hind-centrals a trapezoid whose anterior side is shortest; space between fore and hind intermediate eyes more than diameter of a fore-central; interval between laterals, which are seated on slight eminences, nearly equals space between hind-laterals and hind-centrals.

Relative length of *legs* 4–2, 3–1 = 23, 18 mm.; in some

* Since this paper was read, through the courtesy of P. Goyen, Esq., of Dunedin, I received a brief description of Koch's *H. rogenhaferi*, to which *H. plautus* bears so close resemblance that it may not retain specific rank.

examples 4, 2, 3, 1; yellowish or reddish-brown, sparsely furnished with fine erect hairs; 1 or 2 spine-like bristles on femora, upper side; i.–ii. pair rather stoutest; 2 spines at base of metatarsi; tibiæ of ii. pair 1 spine; tibiæ of iii.–iv., 3 spines; metatarsi, 5 spines; exinguinal joint of iv. longest. Tarsal claws, 1st pair, coarse, slightly sinuated, free, and curved into a hook; inner claw, 15 teeth; basal end has 12 long fine comb-teeth increasing in length, 3 coarse at extremity of row, curving backward; outer claw 12 sparse teeth, increasing greatly in length and strength, curving backwards; 4th pair, inner claw, 10 teeth increasing greatly in length, 4 terminal teeth sparse; outer, 8 coarse open teeth. The number of teeth on the claws differ in different individuals. Probably the maximum number are given in the described example. Claw-tuft and scapula hairs moderately long, fine, terminal half linearly incrassated, serrated; latter hairs extend to base of matatarsi on i.–ii. pairs.

Palpi like legs in colour, strong; long black hairs, spine on humeral joint; digital joint densely clothed with short hairs, 2 long spines beneath palpal claw, which is fine, curved, about 5 teeth.

Falces strong, conical, very gibbous, base projects forwards, apices outwards; glossy, reddish-black; fang long, fine.

Maxillæ tumid at base, fore-half linear, rounded at apex, directed outwards; strong hairs on inner margin.

Labium conical, roundly truncated, more than half length of maxillæ, attached to a broad, projecting, collar-like process; these organs have a reddish-brown colour.

Sternum oval, or somewhat vase-shaped, owing to neck-like development of fore-part; brownish.

Abdomen elongate-oval, squarely truncated at base; very depressed; colour, graduated tints of light slate and yellow-stone, latter tint predominant on dorsal and ventral surfaces; sparsely clothed with yellowish pubescence, fine plumose hairs, and coarse black hairs; impressed spots prominent; spinners moderately long. *Vulva* large; anterior portion consists of a reddish-black oval, slightly concave, transversely wrinkled eminence, integument on either side towards posterior end swells out into somewhat pear-shaped protuberances, olive-green, or glossy red-brown.

The colouration and remarkably depressed form of this species indicates its natural haunts; mature examples may be found throughout the year under exfoliate bark, etc.; movements rapid. Cocoon constructed in crevices, oval, lenticular, 2 to 3 metres long, composed of soft, close, white silk, attached by its inferior surface, contains about 60 pale-coloured eggs, not adherent among themselves.

Dunedin, *P. Goyen*; Auckland, *A.T.U.*

Fam. LYCOSIDÆ.

Genus **Lycosa,** Latr.

Lycosa proxima, sp. n. Plate VIII., fig. 7.

Length of a mature male or female, $2\frac{1}{3}$ mm.

Cephalothorax oval, slightly constricted in front; somewhat transversely rugose; light yellowish-brown, light and coarse dark hairs; two wide olivaceous bands extend from posterior eyes to base of thorax; faint, somewhat depressed, brown line along dorsal surface; profile line rises from thoracic junction at an angle of 65°, horizontal as far as third row of eyes, then dips rather abruptly. *Clypeus* directed moderately forwards, in height rather more than space between fore-central eyes; olivaceous bands extend from latter eyes to margin.

Anterior row of *eyes* smallest of eight, curved; intermediate pair slightly the largest, black, rather more than their diameter apart, and nearly twice that space from exterior eyes of same row, which have a reddish-pearly lustre, placed on dark collars; eyes of second and third rows have a reddish hue, seated on reddish lake-coloured tubercles; second row shorter than first, third about equal.

Legs moderately long and slender, nearly equal in length, apparently 4, 1, 2, 3; light yellowish-brown; armature dark hairs, numerous long erect spines; superior tarsal claws, 1st pair, curved, free, and directed somewhat forwards, about 9 small comb-teeth, increasing slightly in length, pointing forwards; inferior claw short, sharply bent, apparently no teeth.

Palpi moderately long, resemble legs in colour and armature; humeral joint stout, two long erect spines on upper side, rather exceeds cubital and radial joints in length, latter articles about equal in size, somewhat cup-shaped, furnished with strong bristles; projecting upwards from fore-part of radial joint is a stout spine, and a short, broad, curved, dark process, upper margin of which is furnished with a row of short comb-like teeth, is produced on outer side at its articulation with the digital joint, which is oviform, partially cleft at tapering apex, convex, and moderately hairy externally; basal end of inferior surface somewhat bulb-like; fore lobes terminate at apex with short, dark, serrated, membranous projections.

Falces conical, directed slightly inwards; fangs short; normal hue; olivaceous streaks on frontal margin are continued along entire length of falces.

Maxillæ enlarged at apex, about as broad as long, somewhat roundly truncated on inner side, normal yellow-brown hue.

Labium short, somewhat oval, dark.

Sternum heart-shaped, brownish.

Abdomen oviform, widest towards posterior end, yellowish-brown, clothed with light hairs; two wide olivaceous bands

extend from base to spinners, apparently an extension of bands on cephalothorax. A broad band extends across ventral surface, covered with prominent brownish papillæ.

Female does not differ essentially from male, either in size, specific pattern, or colouration. *Palpi* resemble legs in colour, armed with strong bristles; palpal claw fine, long, straight, no teeth. Papillæ absent on ventral surface of abdomen.

These interesting little spiders were captured on manuka; bear a close resemblance both in colouration and form to a rather common species of *Oxyopes* (*O. gregarius*), which, in following Blackwall, was assigned in my former paper to the genus *Sphasus*, Walck.

Te Karaka, Auckland, *A.T.U.*

Fam. ATTIDÆ.

Genus **Attus**, Walck.

Attus auricomus, sp. n. Pl. VIII., fig. 8.

Length of an adult female 7 mm., and of an adult male 7½ mm.

Cephalothorax one-third longer than broad, widest at fore part of caput; red-mahogany colour, suffused with dark-brown, sparingly clothed with pale-yellow, golden-orange lanceolate, and strong black erect hairs; median fovea large, shallow, nearly circular; ocular area more than one-third of cephalothorax; profile line rises from thoracic junction at an angle of 45°, runs horizontally as far as posterior lateral eyes, then slopes moderately across caput, which is prominent in front. *Clypeus* directed inwards, very narrow, furnished with few white hairs.

Space between posterior lateral *eyes* rather more than interval between them and anterior laterals, latter pair furthest apart, and form with fore-centrals a slightly curved transverse row; anterior row half the diameter of a fore-lateral eye apart.

Legs moderately strong, relative length 1–4, 2, 3; fore-pair reddish hue, suffused with chocolate-brown, hind pairs pale yellow-brown; general joint nearly equals tibial in length, metatarsi rather longer than tarsi; armature short and long fine hairs, 3 spines on upper side of femora, normal number on tibiæ and metatarsi, spines on latter remarkably long; tarsal claws sinuated, long; 1st pair, outer claw 1 strong curved tooth, near centre; inner claw 11 teeth, 10 short, 1 long, curved tooth; 4th pair, outer claw 17 teeth, 16 small close, 1 strong tooth; inner claw 10 teeth, 9 open comb-teeth, 1 strong tooth; hairs of claw-tuft gradually dilated, upright, spreading.

Palpi moderately long, brown, black and white hairs, short curved spine at end of humeral joint.

Falces short, broad, flat, rugose, bright red-mahogany colour.

Maxillæ long, spathulate, red-mahogany hue, apices pale.

Labium rather less than half length of maxillæ, dark-brown, apex round, everted, pale.

Sternum oval, yellowish-brown.

Abdomen elongate-oviform, projects over base of cephalothorax; brown, clothed with bright yellow and erect black hairs; median band, broad-lanceolate, margined with dark-brown, on the basal half there are a series of angular brown marks, apices directed forwards; between latter and spinners, which are long, there is a tapering brown mark; ventral surface light-brown, two dark lines converge posteriorly from bronchial opercula.

Genital eminence moderately prominent, convex above, concave within, orifice oval, projecting from above is a tapering process directed backwards.

Male slightly exceeds female in length, resembles her in form and colouring, specific pattern more defined; median band of cephalothorax formed of yellow and bright orange-red lanceolate hairs, in some examples nearly covering ocular area, tapering towards and bifurcating at thoracic junction; marginal zone fringed with yellow hairs. Anterior *eyes*, like those of females, are encircled with an iris of golden orange-red hairs. *Clypeus* thickly bearded with short pale-yellow hairs.

Legs differ from female's in relative, 1, 2, 4, 3, and exceed hers in actual length; first pair red-mahogany colour, suffused with brown, hind pairs pale-brown, darker and faintly annulated towards extremities; outer tarsal claw, 1st pair, 1 strong curved tooth near centre; inner claw 19 teeth, 18 small, close teeth, increasing slightly in length, terminal tooth long, curved.

Palpi moderately long, strong black hairs; humeral joint greenish-brown, projects a short, curved black spine on upper side near its articulation with cubital joint; humeral rather exceeds cubital and radial joints in length, the latter is one-third shorter than cubital; a black curved, horn-like apophysis projects on outer side, at articulation with digital joint, which is a rather narrow oval, has red-mahogany hue of former joints, convex above, convexities directed towards each other; palpal organs simple, inferior surface somewhat pointed bulb, a reddish beaded band extends from base beneath upper fold, curving upwards near apex.

Captured in June beneath old bags, Te Karaka, Auckland, *A.T.U.*

Attus zanthofrontalis. Plate VIII., fig. 9.

Salticus zanthofrontalis, A.T.Ur. "Trans. N.Z. Inst.," 1884.

Length of an adult female, 4–5 mm.

Female does not differ much from male, abdomen larger, first pair of legs shorter, relative length 1–4, 2–3; femora, 1st pair, tumid, genua and tibiæ strong, nearly equal in length, metatarsi about two-thirds length of tibiæ, tarsi rather shorter; tarsal

claws moderately strong, curved, inner claw has 7 small close teeth, outer none; hairs of claw-tuft somewhat spathulate.

Palpi resemble legs in colour, armed with hairs and bristles.

Vulva convex, orifice transverse oval, margin of hood, or labrum, produced into a short pointed process, directed backwards; labium prolonged into a reddish pointed process, directed forwards, longer than upper process.

Var. *hirta.*, nov.

This variety is more thickly clothed with hairs, especially in *female* examples. *Cephalothorax* brown-black, covered with yellowish and erect black hairs, white patch usually behind posterior lateral eyes. *Abdomen* clothed with similar hairs; series of white, somewhat angular marks, apices directed forwards, extend along median line; white oblique streaks on lateral margins. Dorsal marks on *males*, which are less hairy, take the form of spots. *Legs*, more especially in male examples, furnished with numerous long flexible erect hairs.

Both forms numerous about sunny clay slopes. Te Karaka, Auckland, *A.T.U.*

Attus saxatilis, sp. n. Pl. VIII., fig. 10.

Length of an adult female, 5–6 mm.

Cephalothorax rather longer than broad, rounded posteriorly, sides abrupt, glossy dark-brown, caput lighter; coarse black hairs about ocular area; median fovea large but shallow; contour of profile rises at an angle of 45°, then slopes across caput, which is moderately prominent in front. *Clypeus* furnished with long white hairs directed centrally, in height less than diameter of a fore-lateral eye.

Ocular area occupies rather more than one-third of cephalothorax, broader than long; anterior row of *eyes* sensibly curved, slightly parted, laterals nearly half their diameter from intermediate pair, posterior laterals form a transverse line with fovea, are rather smaller than anterior laterals, interval between them rather less than that between the latter pair; irides encircling fore-row whitish; small laterals equidistant between fore and hind-laterals.

Legs short, slight, relative length 4–3, 1–2; yellowish-brown; armature hairs, spines normal; tarsal claws, 1st pair, sharply curved, about 13 short, close teeth on inner claw, 2 coarse teeth on outer; claw-tuft strong, hairs linear.

Palpi yellowish-brown, long light hairs.

Falces short, vertical, greenish-brown, fangs short.

Maxillæ as broad as long, truncated on inner side; pale straw-colour, slightly suffused with olive-green.

Labium broad-oval, nearly half length of maxillæ, similar tints.

Sternum oval, black, light hairs.

Abdomen ovoid, slightly longer than cephalothorax, brown-black, sparingly furnished with short light hairs. *Vulva* moderately prominent, convex; margin of hood forms a transverse, lightish brown intumescent lip, extending to branchial opercula.

Shingle slopes, Two-Thumb Range, Lake Tekapo, Canterbury, *A.T.U.*

EXPLANATION OF PLATES VI.-VIII.

PLATE VI.

Fig. 1. *Linyphia diloris*, sp. n., *a*, male; *b*, female; three times natural size; *c*, palpus of male in two positions; *d*, vulva; *e*, claws of fore-leg and maxillæ, labium of female.

Fig. 2. *Linyphia trisphathulata*, sp. n., male and female; five times natural size; *a*, palpus of male in two positions; *b*, vulva.

Fig. 3. *Theridium varium*, sp. n.; *a*, male; *b*, female; twice natural size; *c*, palpus of male in two positions; *d*, claws of first part of legs; *e*, vulva.

PLATE VII.

Fig. 1. *Theridium veruculatum*, sp. n., female; four times natural size; *a*, vulva.

Fig. 2. *Theridium blatteus*, sp. n., female; seven times natural size; *a*, vulva.

Fig. 3. *Theridium pumilo*, sp. n.; *a*, male; *b*, female; eight times natural size; *c*, palpus of male; *d*, maxillæ, labium, and sternum of female; *e*, vulva; *f*, claws of anterior leg.

Fig. 4. *Theridium calyciferum*, sp. n., female; four times natural size; *a*, vulva.

Fig. 5. *Theridium cruciferum*, sp. n., female; four times natural size; *a*, vulva.

PLATE VIII.

Fig. 1. *Theridium triloris*, sp. n., vulva; *a*, palpus of male in two positions.

Fig. 2. *Theridium squalida*, sp. n., vulva.

Fig. 3. *Theridium setiger*, sp. n., vulva.

Fig. 4. *Theridium zantholabio*, sp. n., vulva.

Fig. 5. *Theridium sericum*, sp. n., vulva; *a*, maxillæ, labium, and sternum.

Fig. 6. *Hemiclæa plautus*, sp. n., cephalothorax of female; *a*, profile with legs truncated, twice natural size; *b*, vulva; *c*, maxillæ, labium, and sternum.

Fig. 7. *Lycosa proxima*, sp. n., profile of cephalothorax with legs and palpi truncated; 7*a*, palpus in two positions.

Fig. 8. *Attus auricomus*, sp. n., palpus of male and vulva.

Fig. 9. *Attus zanthofrontalis*, vulva.

Fig. 10. *Attus saxatilis*, sp. n., vulva.

ART. XXXVIII.—*Description of* Diadema nerina.

By R. J. KINGSLEY.

[*Read before the Nelson Philosophical Society, 13th April,* 1885.]

OF the Order Lepidoptera, New Zealand appears to possess but a comparatively few species, especially when we consider how lavish nature has been in this respect in both number and

beauty with Australia and the adjacent islands, and America; even Britain is far better off in variety than this colony. Of the few we can boast of, the specimen which I have the pleasure to exhibit is, I believe, one of the largest and most beautiful.

It was caught in a garden, near the Normanby Bridge, on the 18th of last March, and is the only specimen I have hitherto met with.

In vol. ix. of the Transactions I believe there is a notice of the capture of the only other female specimen recorded; it was captured by Thomas Tanner, Esq., of Hawke's Bay.

The male has been several times met with, but still not frequent, since the Rev. Richard Taylor, of Wanganui, states he only observed two in a period of thirty-two years. Dr. Barker also saw one in a garden at Christchurch.

I have affixed the name *Diadema nerina* to this specimen, but I am not absolutely certain whether it may not be a distinct variety, inasmuch as it does not quite coincide with the description of this species given in Mr. Enys' book "On the Butterflies of New Zealand," published in Christchurch in 1880.

From that work (which I may state is a reprint from vol. x. of the Transactions,) I gather: "The range of this species is peculiar; it occurs in Java, Australia, New Guinea, and the Loyalty Islands, and a small variety in Samoa."

Dr. Semper, in his work, says:—"In Samoa the larva lives long after it is adult, and then becomes a pupa very abruptly. The pupæ hang suspended everywhere on trees, old stones, etc., and change after twelve days. Breed in November. It is very probable that the habits of *Diadema nerina* would be very similar to that of Samoa."

From this extract it will be seen that this species forms another of the interesting links that exist amongst the fauna of New Zealand, and that of Australia and adjacent islands, each in their way helping to establish the theory advanced by geologists, of these countries, with New Zealand, having in past ages formed one vast continent.

I give my own description of the specimen now before you.

Order LEPIDOPTERA.

Section Rhopalocera.

Sub-family Nymphalinæ.

Species *Diadema nerina*.

Description—Female.—Above black-brown, fringes white, varied; primaries with tawny-red patch extending from the internal border towards the discoidal vein. An oblique whitish band beyond the cell, divided into four elongated spots bordered with a bluish tinge. A double sub-apical whitish spot anterior margin blue tinged, from which extend a series of three small

round blue-edged white spots across the disc towards the oblique whitish band, beyond which they are continued by two small round blue spots to the external margin of the tawny patch; between the oblique band and the tawny patch there is a rather faintly marked blue spot. A double sub-marginal series of interrupted lunulated bluish spots.

Secondaries crossed by a broad whitish patch bordered with blue; a sub-marginal series of spots as in the primaries, but more indistinct; the series of round spots also continued as rather faint blue spots.

Body above blackish-brown; head and pro-thorax white spotted; white vertical dash at back of each eye.

Wings below, red-brown; basal area of primaries ferruginous; basal half of costa black, spotted with white; four black-edged, sub-costal white spots, oblique patch of black brown across disc to middle of costal area; oblique band of five white spots as on the upper side, the extra spot being on the costal area. A double, sub-apical, whitish spot, with series of small spots as on upper, the two blue ones being larger but more faint, a double sub-marginal series of lunulated whitish spots, fringe white, varied.

Secondaries below, a diffused central transverse whitish band; a discal series of white spots, and a double series of lunulated whitish spots; body below red-brown, spotted with white; palpi and inner edge of femora, white; expanse of wings, 4½ inches.

In comparing this description with that in Mr. Enys' book, there are the following differences:—

On the primaries, he gives *five* elongated *white* spots, this has but four, and bordered with blue tinge; he gives a sub-apical *white* spot; this has a *double* white *blue-edged* spot; his a series of white spots; this *two* of the series unmistakeably *blue*, and a blue spot near the tawny patch; his lunulated spots were *white*, these decidedly *bluish*.

On the secondaries, his large spot is edged with either tawny or blue; his diagram shows tawny; this is edged with a *brilliant blue*.

He says nothing of the discal series of blue spots.

Below, he does not mention the oblique band of black-brown, but gives the costal base and anal area as ferruginous, which I fail to observe.

His measurement is 3 inches 9 lines; mine, 4·5 inches.

With regard to the rare occurrence of this species, as well as the *Vanessa antiopa*, or Camberwell Beauty of the British Isles (the latter only observed at regular periods of seven years), I have long had a supposition that the larva of these butterflies may very probably take a much longer period to arrive at maturity, say five or six years; if so, this would fully account

for their only being observed at regular fixed periods. When we are more conversant with the details of the lives of these insects through their different stages of existence, we shall, doubtless, be in a position to give an easy solution to many of the problems that puzzle us now.

Art. XXXIX.—*Life History of* Epyaxa rosearia, *Dbld.*

By A. Purdie, M.A.

[*Read before the Wellington Philosophical Society, 23rd September*, 1885.]

The object of this short paper is to describe the life history of the above moth, and also to correct some errors in Mr. Meyrick's description of the adult insect. These errors are not the result of inaccurate observation, but of having bad specimens. This moth, although not distinguished by bright colouring, is interesting, as being one of those species in which the male and female differ much in colour. So much do they differ, that in the case of most, if not of all, these species the male and female were at first described as distinct species; but this is not so remarkable, for one of these authors has given as many as ten different names to one species.

Taking now the three stages of this insect:

The egg is oval, smooth, and of a pale yellow colour.

The caterpillar is a looper—that is, it has pro-legs only on the 10th and 13th segments; and two specimens of it were found about the 1st of August, nearly full-grown, on water-cress in the mouth of an old mining tunnel near the Waterworks.

Description of caterpillar.—Length, at rest, about three-quarters of an inch. Colour light-green, with indistinct whitish longitudinal lines, and a narrow median dorsal stripe of the ground colour, edged on each side by one of these whitish lines; a subdorsal whitish line on each side of the median stripe; the ground colour shows again as a lateral line, edged below with whitish. Under-side with delicate whitish or yellowish longitudinal tracings, as on the upper side. The junctions of the segments show yellowish or whitish rings when the larva contracts.

Head, greenish-yellow. Body tapering somewhat to the head.

Chrysalis enclosed among the withered leaves of the cress above ground; very dark brownish-black, glossy.

A pair of the perfect insects emerged about the second week of September. Mr. Meyrick's descriptions are evidently taken from more or less faded cabinet specimens: hence there are errors unavoidable in the case of a naturalist not having access

to fresh specimens. In specimens kept for some time the male is, as he describes, pale whitish-grey, with the median band of the forewings more or less distinctly outlined with black, especially opposite the cell; while the female is ochreous or of a pale sandy colour, with faint traces of the usual markings.

But in quite fresh specimens the insects are much more ornamental. The male is darker than above described, usually of a rosy or warm-tinted grey as ground colour in the forewings. The outer side of the basal patch and both sides of the median band are edged with a greenish-yellow line, showing distinctly on the unfaded ground-colour. The fringes are also rosy-grey. Mr. Meyrick states that the male is very constant in colour and the female variable; but the reverse is rather the case, faulty specimens having led to this misstatement, for the female suffers most when preserved in a cabinet. The true colour of the forewings of the female is dull yellowish-green; but the common methods of killing—for instance, by bruised laurel leaves—destroy the colouring of green moths. Collectors may note this caution against exposing fine green moths to the fumes of prussic acid. By lantern light the female seems to be of a glaucous or peculiar blueish green, which serves at once to distinguish it. The green colour of the female seems dingy and faded if placed beside the rich green of *Cidaria similata*, but if compared with the dull greys of allied *Geometrina* it seems peculiar and noticeable. The ordinary markings are not very distinct in the female. The hindwings are often a dull blackish-grey. The yellowish colour ascribed to the female is merely the common colour of faded green moths. The two sexes are more dissimilar in their fresh state than when faded; and the green colour of the female may serve as a very efficient protection whilst among foliage.

ART. XL.—*Notes on the so-called "Vegetable Caterpillar" of New Zealand.*

By A. HAMILTON, of Petane.

[*Read before the Hawke's Bay Philosophical Institute*, 1885.]

AMONG the many curious and interesting objects of natural history which have been made known by the collections of the early travellers and voyagers to our Southern seas, very few surpass in general interest the subjects of these notes. The evident vegetable nature of the one part, and the simulacrum of the perfect caterpillar of the other part, presented a biological riddle of the deepest interest, and one which we are yet very far from having solved fully.

At first sight, one might well be pardoned for considering a "vegetable caterpillar" as a specimen of the "mermaid class," cleverly constructed by some ingenious hand, in the same way as the naturalist Waterton prepared his "nondescripts" for his museum; but, more closely examined, Nature triumphs, and not only so, but by the variety of ways in which she effects the same end, illustrates anew the axiom that no two things are exactly similar. For a long time I thought that there was but one simple form, all the specimens that came under my notice, either in England or in this colony, being the more or less desiccated caterpillar, bearing on its head a spike a few inches long, covered near the apex with spore capsules.

A short time since, I visited a part of the bush near Tarawera, on the Napier–Taupo Road, and very carefully searched over a considerable portion of high, bush-covered ranges, near the township, for a rare and interesting plant which I had previously obtained in that locality; and in the course of my day's ramble, I collected the specimens which I have the honour to lay before you this evening.

Taking one of the largest of the specimens, we find that the length of the caterpillar is about 2¾ or 3 inches, and the smallest 1¾ – 2 inches.

The largest caterpillar supported a fungus about 12 inches in length, 2½ inches of this being covered with densely packed spores. The number of specimens collected on this occasion was 16, 10 of which were mature, having the spore capsules fully developed, and six were immature. Three of the caterpillars were markedly smaller than the remainder, but, as far as could be seen, presented no specific differences. In all of the smaller specimens, however, the frontal shield, or scutellum (if any), was destroyed by the growth of the fungus.

Three of the caterpillars bore, what was then quite new to me, two or more spikes. The most remarkable of the three was a caterpillar 2½ inches long, bearing a stout fungoid spike, which ascended for 1½ inches, and then bifurcated, each branch being 9 inches in length, both being covered with spores for about 3 inches from the point. The second bore two spikes, each 6 inches long, both arising from the point of junction with the body, and both fertile. The third bore a many-branched spike, having nine points.

In the large majority of instances, the vegetable growth is seen to have arisen from the centre of the junction of the head and the scutellum, but in others, from either the right or left lobe of the head. In one case it occurs at the side of the first thoracic segment, and quite recently I have received from Major Scannell, of Taupo, a caterpillar bearing a spike at each end of the body; this being but the second time he has seen such a case occur, out of many hundreds of specimens.

The line of growth is, in all my specimens, coincident with the length of the body of the caterpillar, so that, if the caterpillar be placed in a crawling position, the "bulrush" extends in front of it like the bowsprit of a vessel. This is quite different to any of the engravings that I have seen in various books. Uusually the spike is represented as growing at right angles to the body, and the caterpillar is gaily crawling on the ground, bearing the spike, whilst what is presumed to be the perfect insect flies away in the distance. And now to return to my own specimens. All that I obtained I found buried in the ground in the dense bush, with but a very small proportion of what I have called "the spike" visible, and considerable care is required to dig out a specimen without breaking it, especially the finer ones.

In an article recently published in a Southern paper giving a lively account of this vegetable caterpillar, the statement is reiterated, which is found in all books on New Zealand, that the Aweto, or vegetable caterpillar, is only found under the rata tree (*Metrosideros*). Now, in the part of the bush from which my specimens came, there is no rata, and to find specimens it is best to look under the papa-namu (*Coprosma grandifolia*).

No trees can be more unlike than the *Metrosideros* and the *Coprosma*, and yet the larvæ probably feed on the leaves of either tree. It is possible that the differences perceptible in the caterpillars in the dried state might be more easily examined and determined when in the living and perfect state, but I have not yet had any opportunity of examining living specimens.

I believe vegetable caterpillars have been found in nearly all the forest districts of New Zealand. I have seen them from the Seventy-mile Bush (the Puketoi Ranges), Te Aute, Te Haroto, and Tarawera in this neighbourhood, and from various parts of the Wellington Provincial District.

And now let us examine a specimen a little more closely, and compare it with similar instances from other countries. On making a transverse section across the sporiferous portion, a closely-packed ring of conidia or spore-cases is seen arranged round a woody axis, the structure of which is not well-defined. The spore-cases, under the microscope, appear like grapes of a rich brown colour, and some appear to show a light spot near the outer end of the longer axis, through which probably the sporidia are discharged. Intermixed with the spore-cases occur numbers of what are probably linear sporidia, slightly twisted and jointed; sometimes these occur in tufts. In the "Handbook of the New Zealand Flora," the caterpillar-fungus is placed under *Cordiceps*, but in more recent works on fungology it appears as *Torrubia*, owing to the discovery by Tulasne of secondary forms of fruit.

Why this fungus should attack this particular species of caterpillar is at present a mystery. Kindred forms are found generally distributed over the world. Perhaps even more striking than our endemic species is *La Guêpe Végétale*, or vegetable wasp of the West Indies. In this case the wasp has been observed flying about with part of its body filled up with the mycelium of the partly-developed fungus (*F. sphæcocephala*).

In this case it is beyond doubt that the insect dies from the growth of the fungus, and that the fungus is not the subsequent intruder, as has been suggested in the case of our caterpillar. Another case in point, in which the fungoid growth certainly causes the death of the host, is the silkworm disease (muscardine). In all cases which have come under my notice the whole of the body of the caterpillar has been filled with the mycelium of the fungus, and nearly all traces of the internal structure obliterated.

It is well known that many of the larvæ of the larger moths hybernate for indefinite periods, and take a considerable time in coming to the pupa state. It may be that, during the dormant period of hybernation, the sporidia may work down the burrow of the insect and germinate, ultimately reducing the animal to the state in which we find it. It seems natural that a caterpillar when hybernating should remain with its head to the surface, ready to emerge when better times come round; and this would account for the general position of the fungus, quite as well as the theory that the spores become fixed in the interstices between the segments whilst the animal is entering the ground.

About twenty-five species of this genus of sphæriaceous fungi have been described in South Carolina; one in Pennsylvania, on a beetle, and one on a moth; one in Cayenne, two in Brazil (one on an ant), two in the West Indies, one in New Guinea, and one in Senegal. In Australia two species have been recorded. Dr. Hooker found two in India, in the Khassya Hills; three have been found in Great Britain, and one has been found in China, where it bears a great repute as a medicine, to be administered as stuffing to roast duck.

The genus *Cordiceps* (Fries), in the "Handbook of the New Zealand Flora," contains two species: *C. robertsii* (Berk.), and *C. sinclairii* ("Hbk. N.Z. Fl." p. 338). The second species is totally different in general appearance, and attacks the larvæ of one of the *Cicada*, or Singing Locust. Every year four or five of these vegetable-locust grubs are found in digging over a small patch of garden ground in the Petane Valley. I regret that I have not had time to examine these specimens closely, and consequently cannot offer any further remarks on them. I also regret that I am unable to lay before you the moth (*Hepialus virescens* ?) into which, if unmolested by the fungus, the caterpillar is said to develope. Any resident in the neighbourhood of any locality where vegetable caterpillars are found, might

add materially to our information on this subject if they could obtain for examination a number of living caterpillars. These might be obtained by spreading sheets under the tree in which they are supposed to occur, and then beating the foliage. We might then find out if any cases occur of the mycelium developing previous to hybernation.

ART. XLI.—*On the Metamorphosis of the Caddis Fly.*

By G. V. HUDSON.

[*Read before the Wellington Philosophical Society, 24th February,* 1886.]

Plate IX.

THE following paper is a short description of the metamorphosis of a species of Caddis Fly (*Phryganidæ*) which I have worked out during the past spring, and which, I believe, differs in several respects from any previously described. The imago is also interesting, as it bears such a close resemblance to a Lepidopterous insect; and, were its preparatory states unknown, it would very probably be catalogued as one of the *Tineina.*

Many entomologists are inclined to regard the *Phryganidæ* as a family of the *Lepidoptera,* and there is no doubt that a very close affinity exists between them; in fact one family of typical *Lepidoptera* (the *Hydrocampidæ*) are strictly aquatic in their habits, the larvæ constructing cases of duckweed, which they pull after them, holding on to the case inside by two hooks, exactly like the caddis worms; the pupa state is also passed floating on the surface of the water, and the moths are commonly taken flying over ponds during the summer.

The larva of this present insect (fig. 1) may be found commonly in the green, slimy weed floating in large masses on all stagnant waters. Being very small, it is rather difficult to detect, and is best procured by washing a small quantity of the weed in a saucer of water, when the little insects will be at once seen walking about at the bottom. On examination with the microscope, the case will first arrest attention, being of a most unique structure; its shape is best described as closely resembling that of a minute flask, very much flattened at the lower end, and almost transparent; its surface is slightly corrugated, and the neck of the flask constructed of a much denser material than the rest. It is open at both ends, the posterior end being perforated by a long, shallow slit, which extends for nearly the whole width of the case, thus admitting a free circulation of water round the larva, who is also able to turn round and project his head and anterior segments through the lower aperture, thus occupying the reverse position to that shown in the illustration. He is, however,

prevented from actually leaving the case by his abdomen, which is too large to be withdrawn from either end. The head and thorax of the larva are very strong in comparison with those portions permanently retained inside, the legs being constructed to fold up into the smallest possible compass, a cavity existing in each joint for the preceding one, this being a structure which is almost universal among the caddis worms. The two organs situated on the posterior segments are doubtless respiratory in their function, a large air-tube taking its rise from each, and ramifying through the body in all directions.

When alarmed, these insects retreat into their cases with lightning rapidity, remaining concealed until the danger is passed. Their food probably consists of the green weed, although they are perhaps carnivorous, feeding on the rotifers and other animalculæ, which swarm in the water where they are found.

With regard to the method employed by the young larva in constructing, and subsequently enlarging, his case, I can give no positive information, although it is undoubtedly made of a viscous fluid secreted by the insect, which hardens when exposed to the water; this secretion is no doubt analogous to the silk of caterpillars, which always exists in the form of a gummy fluid before being spun. In a few Lepidopterous larvæ (*Cerura*, etc.) it is employed as such to construct the cocoon, which is consequently of a much stronger consistence than where the ordinary silk is used. When about to change, the insect fixes his case down by four ligaments, two at each end, the extremities of these being firmly fastened on to a stone; he then closes the small aperture, and constructs a curious arch-shaped partition of dense material inside, a short distance from the broad end (fig. 2). In about a week's time he is transformed into a pupa, having the limbs, etc., free from the body, but incapable of motion. The fixing down of the case prior to the change may be easily performed by the larva from each of the apertures, which are no doubt left open till the last for this purpose. Before the final transformation the pupa breaks through the partition at the broad end of the case, and wriggles to the surface, the imago ascending a blade of grass to dry and expand its wings. The little exuvia of the pupa may be often noticed floating on the water, and the empty cases are very conspicuous on the sides of a glass aquarium, where the insects generally fix them down when in captivity.

This Caddis Fly (fig. 3) must be tolerably common during the summer, but owing to its small size would not be likely to attract attention. I have never observed it in a state of nature, all my specimens having been reared from the larva. It is probably undescribed; but as there are no catalogues of these insects at present published, it is impossible to speak with certainty on this point.

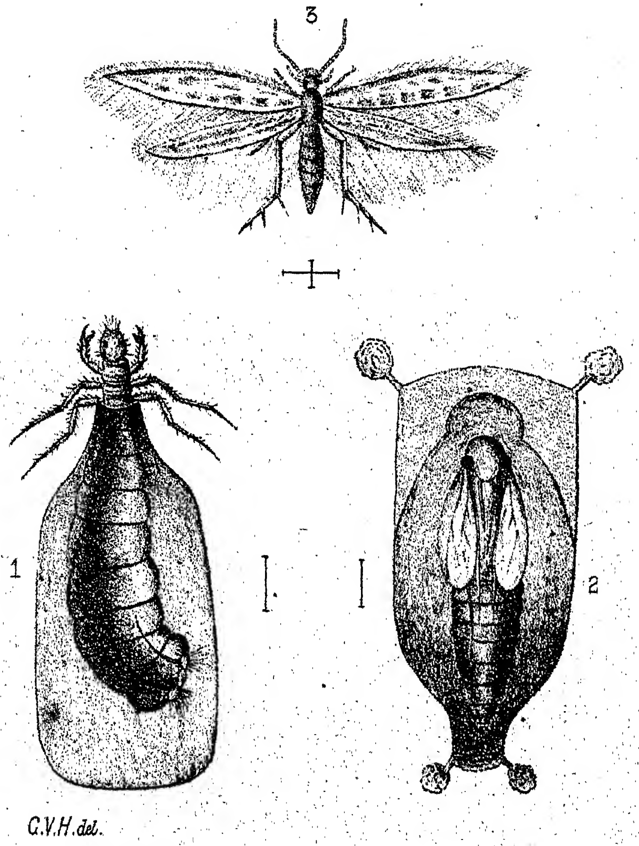

Fig 1. The larva in his case. Length when full grown 2 lines, of the case 3 lines.

Fig 2. The Pupa in his cocoon. Length 1⅔ lines.

Fig 3. The Perfect Insect. Length of body 1¼ lines. Expanse of wings 3 lines.

To illustrate Paper by G. V. Hudson.

ART. XLII.—*On some Specimens of* Vorticellæ *collected in the neighbourhood of Wellington.* By T. W. KIRK, Assistant, Geological Survey Department.

[*Read before the Wellington Philosophical Society (Microscopical Section), 15th February,* 1886.]

For some years past, whenever a *Vorticella* has come under my notice, I have made a sketch and taken careful notes. The receipt of a copy of Mr. W. Saville Kent's magnificent "Manual of Infusoria" has enabled me to identify most of the species observed. It should be remembered, however, that the present paper is only the result of a number of disconnected observations, and it must be distinctly understood that I do not for a moment claim to give an exhaustive list of the New Zealand *Vorticellæ;* on the contrary, I believe that there are probably double or treble the number of species here enumerated, and it is hoped that some microscopist, with sufficient time at his disposal to do the subject justice, may be induced to take up the search for and systematic examination of these flowers of the infusorian world.

Vorticella annularis, Müller.

(Saville Kent, Man. Inf., p. 689, pl. xxxix., figs. 28, 29.)

I am doubtful about the identification of this species. Specimens agreeing with Kent's description and figure, except that they were much smaller and the pedicel shorter, were obtained in a stream at Karori in 1880. They were attached to the stems of partially-decayed leaves.

V. marina, Greeff.

(Saville Kent, Man. Inf., p. 685, pl. xxxv., figs. 1-8; pl. xlix., fig. 30.)

Numerous examples are to be found at all seasons of the year in the small rock-ponds which abound on the shores of Port Nicholson and Cook Strait. The body is slightly more tapering posteriorly, and the pedicel is longer than in Kent's description, being fully seven times the length of the body.

V. oblonga, n. s.

Body oblong, nearly twice as long as broad, rounded nearly equally at both ends, encircled by a number of interrupted lines looking like puckers; pedicel stout, four times as long as the body, contracting by loops, and apparently too weak to support the body for long in an erect position, as it gradually leans either to one side or the other till it meets with some object, where it rests for a short time and then resumes the upright attitude. A large species, attached to seaweed.

V. longifilum, Saville Kent.

(Saville Kent, Man. Inf., p. 677, pl. xxiv., fig. 30; pl. xlix., fig. 10.)

Wellington Reservoir, September to February. Collected in 1884–5. Common.

V. campanula, Ehrenberg.

(Saville Kent, Man. Inf., p. 678, pl. xxxiv., fig. 36; pl. xlix., fig. 12.)

Wellington Reservoir, with the last-mentioned species, and equally common.

V. cratera, Sáville Kent.

(Saville Kent, Man. Inf., p. 679, pl. xxxiv., fig. 22; pl. xlix., fig. 14.)

Some specimens so closely resembling this species were obtained from water brought from the Wainuiomata, that I am compelled to refer them to it, although I was quite unable to detect any appearance of the "frill-like aspect presented by the peristome border," mentioned by Saville Kent. The border appeared to me to be perfectly whole.

V. citrina, Ehrenberg.

(Saville Kent, Man. Inf., p. 678, pl. xxxv., fig. 9; pl. 49, fig. 13.)

On *Azolla rubra*, from ditch in Evans Bay.

V. zealandica, n. s.

Body attenuate, from two to three times as long as the greatest breadth, tapering downwards, considerably constricted below the peristome, then swelling for rather more than half the length, when it again becomes constricted; then a nearly circular swelling, giving the posterior end an unusually blunt appearance. Apparently striated perpendicularly, but of this I am not certain, as sometimes the striations were seen, while at others they disappeared, as though at the will of the animal. Pedicel slight, four times the length of the body.

Pond in Newtown Park.

V. elongata, De Fromentel.

(Saville Kent, Man. Inf., p. 686, pl. xxxv., fig. 25; pl. xlix., fig. 42.)

Specimens were taken in November, 1884, from the pond in the Botanic Garden, attached to the leaves of the water lily. The pedicel, however, was much shorter than mentioned by Saville Kent, being never more than three times the total length of the body.

V. patellina, Müller.

(Saville Kent, Man. Inf., p. 679, pl. xxxiv., fig. 28; pl. xlix., fig. 16.)

Newtown Park and Wainuiomata.

V. nebulifera, Ehrenberg.

(Saville Kent, Man. Inf., p. 673, pl. xxxiv., fig. 20; pl. xlix., fig. 1.)

Ditch in Evans Bay, on *Azolla*; Botanic Garden pond, on grass.

V. striata, Dujardin.

(Saville Kent, Man. Inf., p. 684, pl. xxxiv., figs. 15-19; pl. xlix., fig. 29.)

On Algæ in Wellington Harbour, 1883, but not seen since.

V. aperta, De Fromentel.

(Saville Kent, Man. Inf., p. 680, pl. xlix., fig. 17.)

Examples closely resembling this species were obtained in 1884 from the pond in Newtown Park. The body, however, was fully twice as long as wide, and was more constricted beneath the peristome border than shown in Saville Kent's figure.

V. oblonga.

V. zealandica.

III.—BOTANY.

Art. XLIII.—*A Description of some newly-discovered Cryptogamic Plants, being a further Contribution towards the making known the Botany of New Zealand.* By W. Colenso, F.L.S.

[*Read before the Hawke's Bay Philosophical Institute, 14th September*, 1885.]

Introduction.

In my again coming before you with my usual annual tribute, a little basket of gleanings of simples, a small collection of plants gathered in the secluded shades and deep glens of the interior mountain forests, I would beg permission to preface my list of the same with a few remarks *ad rem.*

On this occasion, all that I have to bring belong to the third great botanical division—the class *Cryptogamia*, as it was named by Linnæus. Three of the Orders of this class will be found here represented, though not alike—viz., *Filices*, *Musci*, and *Hepaticæ*. Of the first, or Ferns, I have however only two novelties: one a tree fern of the genus *Hemitelia*, and one a species of *Botrychium*. For this latter we are again indebted to the kindness, mindfulness, and assiduity of one of our members, Mr. H. Hill. Specimens of these two ferns I shall exhibit.

Unfortunately, I shall not be able to show you specimens of the smaller cryptogams, these being all more or less microscopical, so that without a microscope, proper previous preparation of the objects, and patient attention, nothing worthy of notice could be seen.

Of the second Order, or Mosses, there are specimens of three genera—viz., of *Mnium*, of *Cyathophorum*, and of *Hookeria*; one each of the first two genera, and no less than twelve new species of the last-named, *Hookeria*.

Of the third Order mentioned, viz., *Hepaticæ*, or Liverworts, and of the first division, or foliaceous genera, there are 26 species belonging to six different genera; and of the second, or frondose division of that Order, there are also 17 species pertaining to seven genera, making in all a gross total of 59 new species of cryptogamous plants described in this paper.

Those several genera differ greatly, both in size and in their known homes; some of the genera are exceedingly small and rare; in a few instances, until now, only a single known species constituted the genus, as in *Cyathophorum* (a remarkably fine

moss, only found in New Zealand, the islets further south, and Tasmania); also, *Psiloclada* and *Zoopsis*, highly peculiar and beautiful delicate *Hepaticæ*, confined, like the former, to these southern lands. Other small genera, each containing a very few species, are *Fossombronia*, *Noteroclada*, and *Petalophyllum*; while other genera are very large, as *Hookeria*, a handsome and graceful moss, and *Jungermannia*, an elegant *Hepatica*; both of these genera being also found scattered all over the globe, including our native land.

One genus, however, of *Hepaticæ* I must particularly bring to your notice, and this is *Gottschea*, a fine, and pre-eminently beautiful, genus, and one almost exclusively our own; one which Sir J. D. Hooker, in his handbook, rightly calls "a noble genus;" of this charming genus I have had the good fortune to discover twelve additional species, (besides those recorded in the "Flora of New Zealand,") and I have little doubt that many more species will reward persevering and diligent botanists in the future; for, as Sir J. D. Hooker has further truly observed, "this genus is most abundant in New Zealand." Drawings of many of its species will be found correctly and beautifully executed by Sir J. D. Hooker in his "Flora Novæ-Zealandiæ; and, also, by his father, Sir W. J. Hooker, in his justly-distinguished "Musci Exotici," whose admirable copperplate engravings of drawings and dissections of those plants, and a large number of cognate ones from this country, must always evoke feelings of wonder and delight. Sir W. J. Hooker's drawings and descriptions of New Zealand cryptogams were published in 1818, and were made from specimens collected in New Zealand at Dusky Bay, nearly 100 years ago, by Dr. Menzies, who visited this country in 1791, in the ship of the celebrated navigator and discoverer, Vancouver, as the surgeon of the expedition. Dr. Menzies seems to have worked with a will in his pursuit of science, particularly in the acquiring of the smaller cryptogams, then not so very highly esteemed, of which he made a large collection both in New Zealand and at Cape Horn, and also in other countries visited by Vancouver in his voyage round the world. Several of our cryptogams, discovered by him, bear his name; conspicuously among them is that magnificent New Zealand moss, *Isothecium menziesii*, of which I can show you a fine drawing in the "Musci Exotici."

And here I may also briefly notice a very curious double coincidence, or combination of them, that happened at that very period. In 1791, when Dr. Menzies was engaged in the pursuit of science on the inhospitable shores of Dusky Bay, in this country, the celebrated French naturalist, La Billardiere, was similarly occupied on the then equally little known shores of Tasmania and New Holland. And, further still, specimens of

the same fine and peculiar species of cryptogams which were discovered by the one in New Zealand, were also discovered by the other in New Holland. La Billardiere's large 4to. work in two volumes, "Plantarum Novæ Hollandiæ," with nearly 300 drawings of new plants, was published early in 1804. Several of our plants also bear, and rightly so, his name. He was the naturalist attached to the expedition under D'Entrecasteaux, sent out by the French Government to discover the fate of, or obtain tidings of the famed, though unfortunate navigator, La Perouse.

I may also remark that these plants described by me in this paper are only a part, and a very small part, of the lesser cryptogams that I have collected during the past two years. A large number, amounting to several hundred specimens, exclusive of these herein described, have been separately put up for Kew, and will be forwarded thither by an early ship; not, however, that all of them are distinct species, for some are more than once repeated—even as I could, at more favourable and suitable times and seasons, find better specimens.

In mentioning this, a passing shade of mournful thought crosses my mind: namely, that that lot will be the *last*, in all probability, that I with my own hands shall ever collect. Age now, especially when in the dense woods, reminds me that my work of this nature is done. However, for more than half a century, this kind of work has been with me truly a labour of love; one in which the toils, trouble, and fatigue inseparable therefrom have been often forgotten, while enlarged and superior views of God and of nature have continually been attained.

New Zealand has long been noticed as the home of fine and beautiful ferns, but she is also the home *par excellence* of the smaller cryptogams, which, owing to her temperate climate, her many broken gullies—each containing a perennial streamlet—and her dense, shaded, and ever humid evergreen forests, flourish here in great perfection. It is my opinion that scarcely a tithe of those charming and wondrous productions of nature have yet been detected and made known. Rich harvests await her enthusiastic disciples in this direction. May great success and joy of heart ever attend all such.

I have already, in some of my earlier papers read here before you on former occasions, called the attention of the members of this Society to the pleasing, ever-evolving wonders of Nature, as seen in the close examination, the contemplation, and the study of her manifold productions, aided by the microscope. For while, on the one hand, it still remains true that no two leaves, no two blades of grass, are exactly alike in every particular; yet, on the other, the close and wondrous organization, the exact symmetry, and the perfection of all her works is clear and is astonishing. For whether we take, for instance, the tiny

leaf of a minute, slender *Hepatica*, or of a little wee moss, we shall find the truest adherence to the type in the form and the colour, the structure, and the regular shape of its cellules; and so of the still more minute and more compound microscopical parts of their fructification,—as the external and internal teeth, etc., of the capsule of a moss. Here, in these very minute, and too often overlooked if not despised, productions of Nature, is to be clearly seen her trustiness, her regularity, her profusion, her glory, her beauty! Linnæus, contemplating them, truly exclaimed,—"Legi aliquot Dei vestigia per creata rerum, in quibus omnibus, *etiam minimis, ut fere nullis*, quæ vis! quanta sapientia! quam inextricabilis perfectio!"

Class III. Cryptogamia.

Order I. FILICES.

Genus 2A.* **Hemitelia, Br.**

1. *H.* (*Amphicosmia*) *stellulata*, sp. nov.

Trunk erect, 4–5 feet high, stout, girth at base 2 feet, under crown 1 foot 9 inches, dark brownish black below, covered with its own descending fibrous rootlets, that are soft, spongy, and light coloured at tips. Fronds, 26–30 in a crown, spreading, drooping, bipinnate, broadly lanceolate, not acuminate, 5 feet long, 2 feet 4 inches wide at middle, sub-coriaceous but softish, bright green, glabrescent, shining above, under-surface a little paler and finely stippled with white dots; pinnæ rather close set and overlapping, possessing (with segments) a rumpled semi-rugulose yet pleasing appearance, with numerous weak pale-brownish scattered reticulated scales on costæ and veins, especially on upper surface; stipe stout, very short, triquetrous, somewhat succulent and brittle, dark-brown, muricated (as also is lower rhachis), very scaly at base; scales $1\frac{3}{4}$ inches long, sub-ovate-acuminate with long filiform tips, dark-brown-red, shining, margined, margins erose (not serrulate), cells of centre numerous, narrow-linear, of margin larger and sub-quadrate; rhachis stout, sub-cylindrical, flattish above, pale-yellowish-green, sparsely warted throughout (also stipe) with small oblong and round coloured warts, running in a line between pinnæ; rhachis, secondary rhachises, and costæ densely covered above with reddish and yellowish strigillose hairs, and below with scattered long scarious reddish scales; under them is a peculiar short dark-red starry patent sessile pubescence, very closely set, which, with the long scales, though persistent, are easily rubbed off from exposed parts; pinnæ, middle, 14 inches long, 4 inches

* The numbers attached to the genera in this paper are those of them in "The Handbook N.Z. Flora;" but *Hemitelia* is not to be found separate in that work, being placed under *Cyathea*, No. 2.

wide, linear-acuminate, lower pairs distant and very short, 3–4 inches long; pinnules sub-linear-lanceolate, acute, 2 inches long, 8 lines wide, pinnatifid, regular, alternate, petiolate, petioles very short; segments alternate, 3 lines long, 1¼ lines broad, linear, falcate, the upper half coarsely serrate, acute, sessile, slightly recurved, the lowest pair free, petiolate, and crenate, sometimes only the single lowest one is petioled, this segment is always the shortest on the pinnule, divergent and largely crenate-serrate or lobed throughout; veins alternate, white, rather distant, 6-jugate, stout, lower broadly forked, upper simple, extending to margin, prominent below, sunk above. Sori not numerous, and confined to lower portions of segments and pinnules, rather large, obtusely conical, usually two on a segment on the lowest pair of veins just below the fork, and running in a single line on each side of costa of pinnule and close to it, sometimes (but rarely) 3–5 on a segment, especially the lowest pair; capsules numerous, minute, pyriform, shortly pedicellate, at first green, afterwards reddish, shining; spores trigonous; receptacle cylindrical, elongate, stalked, sub-clavate, puberulous; involucre a shallow membranaceous, whitish, and spreading cup, with even margin, marked with fine and closely-waved lines (*sub lens*), extending round costal half or little more of sorus, sometimes, but rarely, surrounding it at base, and, when so, always unequal, being much larger on the costal side, never, not even in the most incipient state, covering the sorus, which is always largely exposed.

Hab. Edges of forests, banks of streams in the Seventy-mile Bush, between Norsewood and Danneverke, County of Waipawa; 1882–5: *W.C.*

Obs. I. A species near to *H. smithii*, Hook. fil., (*Cyathea smithii*, "Flora N.Z.," and also "Handbook"), but widely distinct from that species in many characters (*vide* description, *supra*); although, without close examination and comparison, it is likely to be confounded with it, especially if only herbarium specimens are examined. I was for some years deceived through lack of close investigation, and therefore I have given more minutely its description.

Obs. II. This species (like a few other known ones) is intermediate between the two genera *Cyathea* and *Hemitelia*; and were its sori ever enwrapped in their involucres, it might well be placed under *Cyathea*, but such is not the case.

Genus 31. **Botrychium**, Linn.

1. *B. biforme*, sp. nov.

Rootstock thick; roots many, sub-tuberous, fascicled, straight, vertical, with long spreading horizontal rootlets, yellowish-brown. Plant glabrous. Stipe proper (or lower scape) about

1 inch long, with small ovate and entire membranaceous scales at base. *Sterile fronds* (generally 2): petiole 2–2½ inches long, medium thickness, not stout; lamina broadly deltoid, 3–4 (sometimes, but rarely, 5) inches diameter, triternate, very open and spreading; pinnæ distant on long narrow petioles, the central pinna usually the largest; dark brownish-green; texture sub-membranaceous, when dried wearing a rugulose sub-papillose appearance; veins very narrow, prominent, diverging; segments long, narrow, nearly linear, entire, 1-nerved; nerve very slender, extending to apices; tips acute and ofted bifid and spreading. *Fertile frond* (sometimes 2): peduncle 6–8 inches long, twice the height of the sterile frond, mostly very slender and flaccid, under 1 line in diameter, sub-erect and drooping, straight and flexuous, bright orange-coloured and glossy; panicle small, slender, sub-triangular in outline, 1–2 (rarely 2½) inches long, usually 1–1½ inches broad at base, (sometimes, but rarely, 3 inches broad, and when so the basal sub-peduncles are very long and naked below,) bipinnate, open, few and loosely branched; branchlets very short; light yellowish-green. Capsules small, globose, not crowded, sessile and sub-sessile, and (a few) pedicelled; dark-brown; valves oblong-orbicular, broadly gaping, recurved, margins thickened and reverted. Spores whitish, orbicular, slightly roughish.

Hab. In swamps, near Tahoraiti, County of Waipawa; April, 1885: *Mr. H. Hill.*

Obs. I. This species appears to me to be very distinct from all known ones. It usually bears two sterile and sometimes two fertile fronds. The outer or lower sterile frond arises from the base, is largely sheathing and connate; the upper one springs from the stipe about 1 inch above the lower one. When there are two fertile fronds, both are nearly basal from below the petiole of the upper barren frond, and are of equal length, similar to some species of *Anemia*. In one of my specimens the fertile stipe is single below, but divided a little above, each being of the usual size and length. There is a marked difference between the stipes of the barren and of the fertile fronds. These, of the latter, are of a light orange hue, and very glossy; those of the former are stouter, and of a dull brownish-green colour.

II. It is not, however, wholly to its bearing four fronds from one rootstock that I deem this plant to be a distinct species of *Botrychium*; but also from its linear entire segments, its rich, glossy, slender, flaccid and coloured scapes; its pedicelled capsules; its peculiar shaped valves; its circular spores, and its general outline and loose open appearance. Through the kindness of Mr. Hill, I have received upwards of 20 perfect plants, all good and fresh specimens, and they are very much alike, only one of them slightly differing, and that merely in size.

ORDER IV. MUSCI.

Genus 37. **Mnium**, Bruch and Schimp.

1. *M. novæ-zealandiæ*, sp. nov.

Plant rather large, gregarious, prostrate and creeping; fruiting stem erect, ¾-inch high, stout, densely shaggy, with brown rootlets, leaves rosulate at apex, with creeping barren leafy runners at base, 2–3 inches long, proliferous at apex. Leaves large, 3–4½ lines long, 1–2 lines broad, thin, pale (not yellowish) green, oblong and oblong-obovate, flat or very slightly undulate, very obtuse (sometimes retuse), apiculate, broadly margined, margins entire, slightly subsinuate, sometimes the apical portion is finely and distantly denticulate (but scarcely visible under a lens); nerve very stout, particularly at base, continuous but not excurrent; cells rather small, broadly oblong, alike throughout, obscure; leaves on the runners regularly pinnate, the upper half of each leaf free at the base from stem, alternate, with here and there a smaller leaf between on the under and also on the upper side of the branch. Fruit-stalk mostly single, sometimes two together, rather stout, smooth, erect, 1–1¼ inches high, slightly curved, reddish below, yellowish-green above, bulbous at base. Capsule oblong, 1 line long, cernuous; external teeth dark-brown, obtuse, each having four dark vertical lines, with their transverse bars in pairs and rather close; internal teeth pale, the transverse bars distant, and the ciliæ between (3–4) long, very slender, and finely knobbed at intervals; operculum the length of capsule, conical-subulate, obtuse, recurved. Calyptra very long, smooth, narrow, conical-subulate, 3 lines long; tip filiform, obtuse.

Hab. Low wet open spots in the interior, 1879–80, but always barren; wet shaded spots, sides of the River Mangatawhaiiti, Seventy-mile Bush, County of Waipawa, 1884: *W.C.* Glenross, County of Hawke's Bay, 1885: *Mr. D. P. Balfour.*

Obs. This species is near to *M. rostratum*, Schw., and also to *M. rhynchophorum*, Hook., but, after much close examination and comparison, I am satisfied it is specifically distinct. It differs from *M. rostratum* in its larger size, in wanting the excurrent nerve, and in the shape and size of its leaf and operculum, but more particularly in the teeth of its peristome, which differs very considerably from those of that species, as given by Schwaegrichen (Suppl. I., tab. 79); the external teeth of this species are of a very different colour, their transverse bars are closer and in pairs, each tooth also possessing four dark vertical lines; while the internal teeth are without perforations, with their bars more widely apart, and the intervening ciliæ more slender and knobbed at intervals; also, the vertical lines below the inner teeth do not run straight downwards, neither are the cells there regular, as shown by Schwaegrichen in his drawings,

but are of various angular shapes and sizes. This species also differs from *M. rhynchophorum*, Hook., in its operculum and in its leaves, which (in that species) are of a different shape, with their margin closely serrate throughout, and with large open cells at the base of the leaf. Sir. W. J. Hooker does not give any dissections in his plate, neither full particulars of this moss ("Journal Bot." vol. i.), so that I do not know the teeth, etc., of that species. I notice, however, that C. Müeller (Syn. Musc., vol. i., p. 158) has united those two species with others, but to me they seem very distinct.

Genus 68. **Cyathophorum**, Palisot.

1. *C. novæ-zealandiæ*, sp. nov.

Plant rather large, shortly creeping, sometimes tufted; stipe black, sub-rigid, very short, base and roots thickly covered with brown tomentum; stems sub-erect and decurved, (often pendulous,) flat, lanceolate, 2–5 inches long, ½ inch broad at middle, simple and branched above; branches patent, flexible, sub-opposite and pretty nearly together, and sometimes forked and proliferous. Leaves very thin, pellucid, glossy, bright emerald-green, distichous, sub-ovate-acute, cuspidate, 2½ lines long, sub-opposite, distinct, waved, and sometimes more or less slightly plaited, spreading, falcate, dimidiate, the upper basal portion overlapping the stem, the lower excised and not decurrent, the apical portion finely serrate on three-fourths of the upper margin, and on two-fourths of the lower; nerve 0, but in some leaves there is a very short and faint nerve; the leaves also possess a very short, stout petiole-like black nerve at their extreme base, uniting them to the stem, and from it a nerve-like plait runs into the lamina; cells, very narrow, linear and rectangular, arranged in transversely banded and wavy lines. Dorsal leaves broadly orbicular, strongly and distantly serrate above, very much cuspidate; cusp long, curved, aristate and capillary. The dorsal leaves on the branches, however, are sub-ovate-lanceolate, acute, and their lateral leaves are much smaller; perichætial leaves small, and of two forms: (1) the inner, broad, elliptic or sub-orbicular below, suddenly contracted above, the apical portion long, caudate-acuminate; tip sharply acute with 2–3 serratures some distance below the apex; (2) the outer narrow, acuminate, entire, both nerveless; cells long and narrow. Fruit-stalk erect, short, about 1–1½ lines long, largely bulbous at base, with a constriction between it and the vaginula; capsule oblong, turgid, about one line long, bright-green spotted with red, (sometimes wholly bright-red when mature,) sub-apophysate; and the outer teeth narrow, very acuminate, each with two vertical central lines; the inner teeth with a thick dark central vertical line; operculum small, one-fourth length of capsule, convex or flattish-hemispherical, broader than the contracted mouth of the

capsule, with a slender recurved beak; calyptra very small, $\frac{1}{40}$th inch long, only covering the upper part of the operculum, broadly conical, obtuse, roughish, brownish, the base irregular and slightly sub-crenulate.

Hab. In damp, shady woods, generally scattered among other mosses, etc., on rotten logs, both patent and pendulous; Seventy-mile Bush, County of Waipawa; 1879–1885: *W.C.*

Obs. I have long known this fine moss in its barren state, and, from my first detecting it, I supposed it to be specifically distinct from the only known species of this genus, *C. pennatum*, Brid. During the winter of 1885, I succeeded in obtaining fruiting specimens, which have fully confirmed my supposition. It differs from *C. pennatum* in several particulars: in size, form (often much and largely branched), and in its proliferous habit; when the tips are bowed down low among other mosses, etc., they often take root, and send forth new plants; in shape of leaves, particularly the dorsal and perichætial ones; in structure of capsule with peristome, in operculum, and in calyptra; as shown in both Sir W. J. Hooker's admirable drawings and dissections ("Musci Exotici," vol. ii., tab. 163), and also in those of La Billardiere ("Nov. Holl. Plant.," vol. ii., tab. 253), with their respective descriptions. Sir J. D. Hooker has also, in addition, noticed very briefly two varieties of *C. pennatum* —var. *a. minus*, and var. *β. apiculatum*; but as far as I can make out from his very short descriptions, this species is widely distinct from those two forms also; most certainly from the first, var. *minus*, which is a much smaller moss, with orbicular leaves, etc. (a drawing of it is given in his "Flora Antarctica," vol. i., tab. 62, fig. 3); this small variety was originally discovered by him at Lord Auckland's Islands in 1840; and, subsequently by myself, in New Zealand, on the banks of the upper Rangitikei River, in 1848. From the other variety, *apiculatum*, this species also differs, as that moss is said to have "shorter leaves" than the type, which are also "apiculate." Evidently, only barren or incomplete specimens of those two varieties mentioned by Sir J. D. Hooker were known to him.

This moss has caused me a large amount of extra labour, extending over several years, in revisiting so often those different localities in the high woods where I had detected and marked it, but always in vain until this year. It bears fruit in the autumn-winter, but not then plentifully; many places of its growth may be repeatedly visited, and very many plants examined, without detecting a single capsule.

Genus 71. **Hookeria**, Smith.

§ II. Mniadelphus.

a. Leaves with thickened margins.

* Leaves serrulate.

1. *H. smaragdina.*

** Leaves entire.

2. *H. concinna.*
3. *H. microclada.*
4. *H. amœna.*

β. Leaves without thickened margins.

* Leaves entire.

5. *H. subsinuata.*

** Leaves serrulate.

6. *H. pseudo-petiolata.*
7. *H. ramulosa.*
8. *H. subsimilis.*
9. *H. obtusata.*
10. *H. curviseta.*

§ IV. Eriopus.

11. *H. petrophila.*
12. *H. pygmæa.*

§ II. Mniadelphus.

1. *H. smaragdina*, sp. nov.

Plant small, erect, densely tufted and matted in large spreading patches, 6–8 lines high, much branched; colour a pleasing bright dark-green; stems and main branches reddish-brown; branches straight, linear, very narrow, $\frac{1}{20}$th inch wide. Leaves sub-quadrifariously disposed, very small, close, imbricate, spreading, not much altered when dry; lateral broadly elliptic, dorsal and ventral orbicular, apiculate, narrowly margined, the upper portion very finely and distantly denticulate, but scarcely perceivable under a lens; nerve 1, fine, cellular, extending beyond middle; cells orbicular and very small, but much larger and oblong about base; perichætial broadly ovate, very finely margined, entire, acute, cells large. Fruit-stalk erect, 4 lines long, usually springing from base of stems below leaves, red, shining, smooth, twisted, black at base. Capsule horizontal, narrow-oblong, somewhat sub-pyriform, sub-apophysate and slightly strumose, contracted below mouth; external teeth dark-brown, broad at base, very acuminate with two vertical central lines, closely transversely striate, margins dark ridged (or lined) and wearing a semi-denticulate appearance; internal teeth pale, slender, linear, with one vertical central line and a few distant transverse bars, no ciliæ. Calyptra small, conical, whitish, smooth, base largely fimbriate; fimbriæ spreading, recurved, obtuse; tip acute, black, with 4–10 pellucid, jointed, long white hairs largely produced beyond it, erect and straight.

Hab. On trees and logs, forming large patches; dark shady woods near Norsewood, County of Waipawa; 1885; *W.C.*

Obs. I. A species near to *H. rotundifolia*, Hook. fil. and Wils., but differing in several particulars: as, erect habit and being much branched, leaves broader and scarcely toothed, with smaller cells and longer nerve; perichætial entire; fruit-stalk longer, and springing from base of stem; capsule sub-apophysate and strumose, and calyptra with a peculiar long-haired tip.

II. The outer teeth of these species resemble those of *Hypnum tenuirostre*, Hook., and *Isothecium arbuscula*, Hook. fil. and Wils. It is an elegant little plant, though rarely detected in fruit.

2. *H. concinna*, sp. nov.

Plant procumbent in thick spreading tufts or small cushions, densely imbricate, much branched, soft, pale-green with a dash of yellow, and numerous very fine rootlets. Stems (and branches) brownish-red, 1–1½ inches long, rather stout, flattish, sub-deltoid, pinnately branched; branches numerous, close, irregular in length, ¼–½ inch long; branches linear, obtuse, patent, opposite (sometimes sub-opposite). Leaves very delicate, closely set, and somewhat sex-fariously disposed, broadly obovate-spathulate, about ½ line long, narrowly margined, entire; margin thickened below on narrow basal part of leaf; very obtuse, with a minute apical and mucro from margin only; nerve very fine, sub-sinuous, cellular, and extending two-thirds of leaf, shortly bifid a little below the top, the branch nerve very short; cells hexagonal-orbicular, very small at apex, much larger and oblong-hexagonal at base; perichætial oblong-ovate, sub-acute, cells larger, oblong. Seta slender, flexuous, 12–15 lines long, somewhat compressed, curved, twisted, smooth, glossy red. Capsule horizontal and cernuous (immature). Calyptra nearly 1 line long, enclosing capsule, narrow, glossy, black half-way from apex, largely fimbriate at base.

Hab. On upper branches of high trees, where it forms large and thick patches, and on the ground (but more rarely); dry forests near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species near to *H. adnata*, Hook. fil. and Wilson, differing, however, in its larger size and being much branched, in form of leaf and cells, in length and structure of nerve, in its much longer seta, etc. A very pleasing little species. It does not alter much in drying. Rarely detected in fruit.

3. *H. microclada*, sp. nov.

Plant small, sub-erect, 6–8 lines high, pale yellowish-green; stems stout, red-brown, except their tops, which are the same colour as the leaves; much pinnately branched from base; branches compressed with numerous fine red rootlets below. Leaves sub-sexfariously disposed and nearly alike, very close, imbricate, spreading, delicate, obovate-spathulate, entire, narrowly margined, slightly sub-sinuate, very shortly apiculate from

margin only; nerve single, slender, extending beyond middle; cells orbicular, very minute and partially obscure in the upper half, large oblong and clear in the lower; perichætial broadly ovate, entire, acuminulate; cells large and clear. Fruit-stalk 6–7 lines long, slender, smooth, flexuous, red, black at base, 3–5 on a branch; capsule very small, ob-conical, plain, sub-horizontal, brownish-red, broadest at mouth; outer teeth dark brown, closely transversely striate with sub-denticulate margins (as in *H. smaragdina*, Col., *supra*); calyptra long, conical, covering capsule, smooth, upper half black and glossy, apex much produced, sub-piliferous, base fimbriate; fimbriæ spreading, wavy.

Hab. On trees; dry forests near Norsewood, County of Waipawa, 1885: *W.C.*

Obs. A species pretty closely allied to *H. sinuosa*, Hook. fil. and Wils., but differing from that species, in its being much and pinnately branched, in its leaves being sexfariously disposed, delicate, with a very narrow and much less sinuate margin, and also apiculate; in the large cells of the lower half of leaf, and in the perichætial being acuminulate; also, in the shape of its small capsule, and its much shorter fruit-stalk, and in its smooth and glossy tipped calyptra. When dry its leaves are crisp; it moistens readily.

4. *H. amœna*, sp. nov.

Plant small, erect, $\frac{1}{2}$ inch high, shortly branched at top, yellowish-green; and stems rather thick, dark brown, leaved to base, branches sub-compressed. Leaves numerous, close, imbricate, sexfariously disposed, very small, $\frac{1}{25}$th inch long, broadly spathulate, margined, entire, apical portion sub-orbicular, apiculate, margin very narrow, thickened on the basal portion of leaf; nerve 1, slender, sinuate, extending beyond middle; cells orbicular and very minute in the upper broad part of leaf, large oblong, quadrate in the lower portion; perichætial small, similar in shape, with long cellular acuminate scales within them; cells very large and clear. Fruit-stalk slender, 4 lines long, suddenly curved at apex, flexuous, twisted, smooth, shining, red, black and much thickened at base, springing from a tumid sheath or support (something like *Cyathophorum pennatum*) at middle of stem; capsule minute, $\frac{1}{30}$th inch long, narrow-ovate, pendulous, pale, finely and slightly tubercled at base; operculum not seen. Calyptra (young) narrow-conical, acute, greenish-white below, brown above and black tipped, the narrow upper portion slightly and finely roughish (under lens), largely fimbriate at base; fimbriæ spreading, obtuse.

Hab. Hidden among other mosses, etc. (whence it was picked out long after collecting); dry woods, near Norsewood, County of Waipawa, 1884: *W.C.*

Obs. This species is wholly unlike all others of this genus known to me. Having but a small tuft of a few stems, containing only one fruiting specimen, I did not break it up to examine its teeth, which appear to be very small and slender. It moistens readily.

5. *H. subsinuata*, sp. nov.

Small, tufted, erect, 6–8 lines high, simple (sometimes slightly short-branched at base), linear, broadest at top; stem short, stout, dark-brown, leaved from base; rootlets many, fine, red, at lower part of stem and base. Leaves small, numerous, close, imbricate, sexfariously disposed, all similar, $\frac{1}{2}$ line long, obovate-spathulate, apex very obtuse and shortly apiculate, margin entire and slightly sinuous, light-green, finely nerved throughout $\frac{3}{4}$ths or more of leaf, apical portion of nerve sinuous; cells, upper half exceedingly small, orbicular, the basal portion very large and clear, sexagonal-oblong; perichætial small, oblong-acuminate, hyaline, nerve 0. Fruit-stalk erect, 3–5 lines long, slender, sub-flexuous, red, shining, black at base, 3–4 on a branch. Capsule (immature) narrow-oblong, gibbous above, nearly straight below, sub-apophysate, cernuous, shining, green with small red tubercles at base; operculum short, conical, obtuse; calyptra rather small, narrow, greenish-white, upper portion black, shining, tip acute, recurved; largely fimbriate at extreme base; fimbriæ spreading, sub-curly and waved (not straight), hyaline, linear, obtuse, containing dark-brown linear-oblong masses.

Hab. Among other mosses on rotten logs; low wet woods near Norsewood, County of Waipawa, 1885: *W.C.*

Obs. A species near to *H. flexuosa*, Mitten, but differing in several particulars.

6. *H. pseudo-petiolata*, sp. nov.

Plant small, tufted, erect, $\frac{3}{4}$ inch high, simple and 3-branched at top; stems stout, dark-brown below, green and highly cellular above, with red rootlets at base. Leaves pale green, oval, oblique, obtuse, $1\frac{1}{2}$ lines long, somewhat distant, sub-decussate, serrate, lower margin near base excised and entire, lateral joined to stem by nerve only; nerve 1, very stout, cellular, extending half-way and forked about the middle, branch short; dorsal and ventral leaves similar but smaller, and broader at bases; cells large, sub-orbicular, equal throughout; perichætial very small, nerveless, entire, ovate, sub-acute and acuminate, tip obtuse with (sometimes) two serratures. Fruit-stalk springing from near base, erect, 10 lines high, wiry, rigid, shining, flexuous, dark-coloured, thickened at base, sometimes 2–3 on a branchlet. Capsule small, oblong, horizontal, spotted, finely reticulate, slightly tubercled at base; calyptra narrow conical, 1 line long, smooth, brownish, highly cellular; tip long, curved, acute; base slightly ragged.

Hab. On rotten logs, forests near Norsewood, County of Waipawa; 1884: *W.C.*

Obs. This little species presents a rather novel appearance from its leaves being scarcely broader at base than their stout nerve, and so giving them the appearance of being petioled. When dry, its stems and leaves are dusky green and blackish and completely curled up, but relaxing quickly on being moistened; their tips remaining recurved.

7. *H. ramulosa*, sp. nov.

Plant small, tufted, dendroid, stems 1½ inches high, erect, stout, dark-brown, covered with old leaves persistent below, branched at top 3–12 branches, each branch densely clothed with fine branched brown rootlets; branches narrow, 4–5 lines long, 1½ lines wide, simple and forked, flat, recurved, dark-green (almost black when dry). Leaves quadrifarious, sub-imbricate above, somewhat scattered and distant below; lateral obliquely oblong, broad, obtuse, spreading, small, less than 1 line long, somewhat irregular in size, the upper half of margins sharply and irregularly serrulate; nerve stoutish, shortly bifid, extending not quite to middle; dorsal and ventral elliptic-ovate, sub-acute, nerve short; cells rather small, orbicular, nearly alike throughout; perichætial broadly-ovate, sub-acuminate, very membranaceous, cells large oblong and clear, nerveless. Fruit-stalk erect, 4–7 lines high, smooth, rigid, red-brown, thickened and curved at base, springing somewhat laterally from upper side of branch near base, sometimes two together, and 5–6 on a single plant. Capsule narrow, about 1 line long, sub-horizontal, greenish, finely striate, with a few small and scattered, coloured, smooth tubercles at base. Operculum shorter than capsule, narrow, very obtuse. Calyptra as long as capsule, smooth, naked, cellular, and very much so, and slightly laciniate at base.

Hab. On logs among other mosses; wet shaded woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species near to *H. nigella*, Hook. fil. and Wils.

8. *H. subsimilis*, sp. nov.

Plant small, monœcious, tufted, sub-dendroid. Stem erect, ½–¾ inch high, branched at top into 3–6 branches, sometimes single; colour dusky-greenish. Leaves sub-quadrifariously disposed, 1½ lines long, oblong, slightly obtuse and sub-acute, sharply serrulate, ¾ length from apex, nerved to beyond middle, and bifid near top; cells sub-orbicular, small, but much smaller at margins; dorsal and ventral broader and sub-acute; perichætial oblong-lanceolate, acuminate, entire, nerveless; cells large linear-oblong. Fruit-stalk 10 lines long, erect, slender, flexuous, twisted, slightly thickened at base, dark-brown, springing from upper side of stem, but near base, 2–3 on a branch.

Capsule oblong, spotted with dark-red spots, tubercled, pendulous; operculum long, half length of capsule, acute, and slightly recurved; calyptra long. conical, narrow, obtuse, smooth, laciniate at base.

Hab. In dark, low woods, near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species allied to the preceding (*H. ramulosa*), but shorter and less dendroidal, with fewer branches; leaves much larger, not so dark, and not blackish when dry, with a longer nerve, and minute marginal cells; fruit-stalk much longer and twisted; capsule thicker, tubercled, and pendulous; and calyptra lacerated at base. It is also a much scarcer plant; only a few fruiting specimens obtained. Leaves do not moisten readily.

9. *H. obtusata*, sp. nov.

Plant small, tufted, erect, $\frac{1}{2}$ – $\frac{3}{4}$ inch high, branched from near base, with 3–6 branches, branches recurved. Leaves very small, $\frac{1}{20}$th inch long, rather loosely disposed and sub-imbricate, broadly elliptic, very obtuse, serrate, the young ones and branches light green, very dark green when old, also when dry, fringed at margins below; nerve stout, short, bifid, cellular; cells large orbicular, alike throughout; dorsal and ventral leaves similar but smaller; perichætial broadly-ovate, suddenly contracted and acuminate at apex, entire, nerveless; cells large-oblong. Fruit-stalk erect, 5 lines long, bulbous at base, smooth, dark brown; 2–3 on a branch. Capsule, oblong, drooping; operculum nearly length of capsule, slightly recurved, acute; calyptra conical, smooth, acute, apiculate, entire at base or very slightly ragged.

Hab. In low, wet, shaded woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A peculiar and pleasing little species. Its leaves are often fringed at (or within) the margins on the under side with minute, jointed, cylindrical cellular bodies, in thick, powdery clusters, resembling the *soredia* of some lichens. Sometimes all the leaves on a branch are thus fringed, and, again, sometimes a branch is without any.

10. *H. curviseta*, sp. nov.

Plant small, erect, $\frac{1}{2}$ inch high, sub-dendroidal; stem short, $\frac{1}{4}$ inch, dark-brown, leafy, with numerous brownish-red rootlets at base; 4–5 short sub-rosulate branchlets at top, spreading, decurved. Leaves very thin and pale; lateral sub-oblong-obovate, obtuse, $1\frac{1}{4}$ lines long, upper half coarsely serrulate, the lower basal margin excised; nerve 1, stout, not extending to middle, bifid, the branch nerve very short; cells large, orbicular, pretty uniform throughout, but larger and oblong at base; dorsal and ventral leaves broadly-ovate-orbicular, very obtuse;

perichætial small, narrow-ovate, acute, entire, nerveless; cells large, clear. Fruit-stalk ½ inch long, erect, suddenly curved at top, smooth, red-brown, dark at base, 2–3 springing from axils of branchlets; capsule sub-obovate-oblong, nearly 1 line long, pendulous, pale reddish-brown, spotted with fine red dots, and finely tuberculated at the base usually in a kind of ring around it, minutely reticulated, margin of mouth dark; outer teeth rather short, obtuse, incurved, dark brown, with two broad vertical, light-brown equidistant lines, the centre partially clear, largely transversely striate, margins grossly sub-denticulate. Operculum and calyptra not seen.

Hab. Concealed among *Hepaticæ*, and from rotten logs; woods near Norsewood, County of Waipawa; 1884: *W.C.*

Obs. A species having some affinity with *H. obtusata* and *H. subsimilis* (mihi, *supra*), but differing from both in several particulars. Only two fruiting specimens have been detected, long after journey, among *Hepaticæ* collected.

§ IV. Eriopus.

11. *H. petrophila*, sp. nov.

Plant large, creeping at base, bushy, simple (rarely branched), diffuse; stems numerous, erect, 1½–2 (rarely 2½) inches high, 5–6 lines broad, flat, recurved at tips, of a pleasing bright-green inclining to dark, clothed with leaves from base, with many brown shining branched flattish rootlets below. Leaves sub-quadrifariously disposed, imbricate, thin, margined, margin narrow above, broader at base, upper half sharply serrulate, lower entire; cells large, sexagonal-orbicular, pretty uniform, but smaller and more orbicular at apex, and larger and oblong at base; lateral leaves oblong or sub-obovate, 2½ lines long, dimidiate, spreading, narrowed at base, tip suddenly acute, sharply apiculate, and curved on one side; nerve 1, very stout at base, straight, forked, largely divergent ⅓rd length of leaf; dorsal and ventral leaves smaller, much more orbicular, and more largely apiculate; nerves 2 from base, diverging; perichætial small, transparent, the outer broadly elliptic or sub-orbicular, the inner narrow ovate, all acuminate, the outer being very acuminulate or sub-piliferous, margins entire, serrulate at tips, nerveless; cells linear-rhomboidal, acute. Fruit-stalks 1–2–3 on upper part of stem and near each other, 3–5 lines long, succulent, green, thickened at base with a dark ring, annulated, hairy; hairs very short, thick and sub-tuberculous, patent, larger and longer at top, and these erect and forming a kind of small crest, but very distant from capsule and apex of seta, which are both glabrous, upper part of seta largely glabrous on the under side. Capsule oblong-elliptic, smooth, horizontal, with an elevated ring at mouth and contracted below, sub-apophysate, base slightly tubercled, dark-brown; teeth pale-red,

smooth, with numerous small orbicular cells, margins entire; operculum long, semi-conical, acute, beak very long, slender, straight. Calyptra large, broadly conical, obtuse, $\frac{1}{10}$th inch long, whitish, upper half thickly tubercled (or sub-echinate); tubercles irregular, long, blunt; laciniate and much fimbriate below; fimbriæ ragged, branched, spreading, obtuse, recurved. Monœcious; paraphyses numerous near bases of fruit-stalks; antheridia axillary near capsules, each linear sac clavate, containing a red globular spot near apex.

Hab. On stones in the bottoms of narrow deep watercourses; dark shaded woods near Norsewood, County of Waipawa; 1884–5: *W.C.*

Obs. I. A very fine species, certainly approaching very near to *H. cristata*, Arn.; but, after long and repeated examination, I cannot but deem it to be distinct. It also has some affinity with *H. lophophora*, Col. ("Trans. N.Z. Inst.," vol. xvii., p. 260). It differs, however, from *H. cristata* in size, habit, and form of stems and leaves, and in their colour, and in the form of its capsule, which is also sub-apophysate and tubercled (*vide* Hedwig, Sp. Musc., t. 49); in form and size of apex of leaf and apical cells (*vide* Schwg. Suppt., tab. ccxxviii., figs. A. B.); in its large and broad sub-tuberculous calyptra, laciniated at base; and in the short, thick, patent hairs on its seta and crest; and also in its peculiar *habitat* or place and manner of growth.

II. I have only met with this moss in deep, dark gullies, where it must be nearly always submerged; it clings strongly by its roots to pebbles in the soil, so that the support comes away with the plant in collecting; it bears fruit in June and July. Plants that I brought away living have flourished three to four months in a tumbler of water, in which they are mostly kept submerged.

12. *H. pygmæa*, sp. nov.

Small, tufted. Stems erect, 4–6 lines high, glossy dark-brown below, pale-green above. Leaves loosely imbricate above, distant below, light-green, crisped, and recurved when dry; lateral spreading, rotundato-ovate, largely apiculate, margined, serrate at top and for half-way down; lowest stem-leaves acuminate; nerve 0, or very short; cells rhomboidal, small at apex, increasing in size downwards, and large at base; perichætial long, narrow-ovate, entire, very much acuminate, the mucro subulate sharp, slightly serrulate at tip. Fruit-stalk 2 lines high, erect, flexuous, with a sudden bend at top, red-brown below, very hairy, with short patent hairs broad at bases or sub-muricated, hairs longer above with a crest of long white fimbriæ at top. Capsule small, ovoid, horizontal, apophysate; operculum flattish, with a long decurved acute beak; calyptra small, pale, largely laciniate and fimbriate at base; tip long, brown, shining, decurved.

Hab. Among other mosses on rotten logs; low, damp, dark woods near Norsewood, County of Waipawa, Nov., 1884: *W.C.*

Obs. An interesting little crested species, apparently near to *H. flexicollis*, Mitt. (of which S. Island species, however, I have not seen any specimens, and the description given of it in "Handbook N.Z. Flora" is scarcely complete). At present this species is very scarce, only one small tuft containing three fruiting specimens having been detected, after a most diligent and renewed search.

Order V. HEPATICÆ.

Genus 1. **Gymnomitrium**, Corda.

1. *G. orbiculata*, sp. nov.

Plant minute, erect, short, simple, sometimes with innovations, rarely branched, 6–8 lines high, pale-green, with fine long hyaline rootlets; leaves alternate, orbicular, entire, rather distant below, but sub-imbricate and larger at tips; perichætial large surrounding calyptra 5-lobed, lobes ovate-acuminate, obtuse; fruit-stalk $1\frac{1}{2}$ lines long; capsule dark-brown; valves spreading, broadly lanceolate, much and irregularly reticulate, margins white and slightly sinuate; tips obtuse, naked.

Hab. Sides of perpendicular wet cliffs, River Mangatawhainui, near Norsewood, County of Waipawa; growing very closely intermixed among *Aneura muscoides*, Col.;* October, 1884: *W.C.*

Obs. This species in size and appearance is not unlike the only other known New Zealand species, *G. concinnatum*, Cord., detected by me on the summits of the Ruahine mountain range, its only known New Zealand habitat (but also found in Britain); it is, however, widely different as a species. Its only known habitat is a curious one; closely bound up (or squeezed tightly) among *Aneura muscoides* (*infra*), and only to be detected (when not in fruit) by the extreme tips of its leaves just peering above those of the *Aneura*.

Genus 2. **Jungermannia**, Linn.

1. *J. humilissima*, sp. nov.

Minute, shortly tufted, erect, 3–4 lines high, pale-green, with fine long rootlets below and at base. Leaves laxly imbricate, sometimes more distant, sub-vertical, amplexicaul, slightly decurrent, sub-orbicular, quite entire, apical margins very slightly sinuate, recurved; involucral similar but larger, conniving; cells minutely beaded; apical small, orbicular, basal larger, oblong. Stipules 0; perianth 5-plicate, mouth contracted, toothed. Fruit-stalk 5 lines long, slender, capsule globose, very small, dark purple, glossy.

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* See p. 251 *infra*.

Hab. Closely mixed with other small *Hepaticæ* and minute mosses, wet stony sides of the River Mangatawhaiiti, County of Waipawa; 1885: *W.C.*

Obs. A species having affinity with *J. inundata*, Hook. fil., also found in this district.

2. *J. rufiflora*, sp. nov.

Small, densely and regularly tufted in large spreading patches, erect, 3–6 lines high, pale-green, simple and branched below, connected at base, stems succulent, flexuous. Leaves few, vertical, alternate, distant, sometimes laxly imbricate, especially on old stems; smaller orbicular and pink-margined below, gradually increasing in size, elliptic and sub-apiculate above; semi-amplexicaul, quite entire, very membranous and translucent, somewhat recurved; involucral 1–2, very similar, but larger; cells large, sub-orbicular, nearly alike throughout, the upper minutely and many beaded. Perianth large (for the plant), about 1 line long, obovate-spathulate, 4–5 plicate, mouth large, laciniate, tips pink-red. Stipules none. Fruit-stalk 3 lines long, slender; capsule globose, dark brown; valves broadly oblong-lanceolate, reticulate, slightly margined; tips very obtuse.

Hab. Steep shaded and wet cuttings, clayey sides of main road near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species having pretty close affinity with the preceding species (*J. humilissima*, mihi). It is a striking and neat object in its flowering season, owing to the tips of its numerous and compact perianths being coloured a lively pink-red, and generally each stem bearing one, and all of a uniform height, so that it is detected at some distance when passing by.

3. *J. paucifolia*, sp. nov.

Plant small, tufted, densely compact; stems erect, 4–6 lines high, regular, simple, rarely branched at base, light green, with many fine pellucid rootlets springing from bases of leaves. Leaves few, rather distant, alternate, vertical, $\frac{1}{20}$th inch long, broadly sub-orbicular, somewhat truncate at tip, recurved, undulate and sub-plaited, narrowly margined; margins entire, those of upper leaves sub-sinuate; sub-canaliculate, not decurrent on stem, largest above and very small at base; cells large, oblong, each 5–7 beaded; involucral similar, but larger. Stipules 0. Perianth broadly obovate, slightly compressed, with sinuous edges, apex very truncate, 5–6 plaited at top, mouth contracted, tips curved, acuminate, each with a minute pencil of 3–4 fimbriæ. Seta 2 lines long, slender, twisted, transversely veined. Capsule very minute, globular, dark brown, bursting rather irregularly; valves narrowly margined, obtuse, and much reticulated with black lines.

Hab. In large patches with the preceding species (*J. rufiflora*); patches generally distinct, but sometimes intermixed; 1885: *W.C.*

Obs. This species is nearly allied to the two preceding ones, but distinct. It also flowers much later in the season.

Genus 7. **Gottschea,** Nees.

* Leaves stipulate.

1. *G. læte-virens*, sp. nov.

Plant gregarious, procumbent, imbricate, simple, 1 inch long, 4 lines wide, flattish, sub-linear-obovate, sometimes shortly 2–3 branched near top. Leaves lively emerald-green, very thin, ovate, obtuse, spreading, serrulate at tips, ciliate on upper margins near stem, distant and free below, imbricate and crowded above; ventral lobes more largely serrate at tips; the dorsal of a similar shape but smaller, their upper edge nearly entire, lower edge adnate on ventral lobe; involucral laciniate. Stipules rather large, 4–5-fid, much laciniate and spreading; cells oblong-orbicular, walls thickened; fine purple rootlets on lower part of stem.

Hab. In patches on rotten logs, woods near Norsewood; and more largely on the ground in dark shaded low woods, sides of River Mangatawhaiiti, between Norsewood and Danneverke, County of Waipawa, 1884–5: *W.C.*

2. *G. nitida*, sp. nov.

Plant gregarious, procumbent, imbricate, green, stems stout, 2 inches long, ½ inch wide at broadest part, simple, and 2–3–4 branched; branches patent, irregular, flattish, sub-linear-obovate. Leaves sub-oblong-lanceolate, sub-acute, patent, sharply and closely serrulate, largely ciliate on both margins near bases, but most so on the upper, also at tips, distant and free below, much crowded above; the dorsal lobes oblong, truncate at tip, the upper edge and apex largely ciliate-serrate; ciliæ jointed; lower edge adnate on ventral lobe. Stipules large, laciniate to base, 5–6 lobed, very ciliate; ciliæ long, jointed, drooping, glossy; perichætial pale-green, long, narrow, and much laciniate; cells orbicular, and larger than in *G. læte-virens*; many red rootlets at base and on lower half of stem.

Hab. In patches on the trunks of large trees; dark shaded woods, near Norsewood, County of Waipawa, 1885: *W.C.*

Obs. A fine species, having affinity with the preceding (*G. læte-virens*), which it closely resembles at first sight, but is very different in structure, more compound and larger.

3. *G. macroamphigastra*, sp. nov.

Plant in small patches, sub-prostrate, ascending, pleasing green, stems thick, succulent, oblong, 10–15 lines long, 4 lines wide at broadest part near top, shortly branched, rooted below; root-stock stout; rootlets numerous, short, red, and matted. Leaves spreading, lobes concave; ventral oblong, acute, falcate,

serrate above, laciniate below; dorsal shorter, tips sub-truncate and serrulate, rotund and overlapping at base, and much broader than the ventral lobe, margin there entire, or under a high power minutely serrulate in the anterior portion, the apical serrulate on both margins with a narrow plait extending from lower point of apical margin to outer margin of ventral lobe; involucral narrow, 2 lines long, much and compound laciniate, connate at base; cells orbicular. Stipule very large, sub-quadrate, 1½ lines wide, sub-bilobed at tip, much laciniate; laciniæ largely cellular throughout.

Hab. On rotten logs, among other *Hepaticæ* and mosses, Seventy-mile Bush, County of Waipawa; 1883: *W.C.*

Obs. A very distinct species, from its large and broad stipules, and the concave lobes of its leaves; hitherto, however, it is rather scarce.

4. *G. heterocolpos*, sp. nov.

Plant small, procumbent, spreading, pale green, stems stoutish, leaved to base, 1–1½ inches long, 3–4 lines broad, much (5–6) branched, branches short, flattish; rootlets purple, very numerous, short and matted below. Leaves sub-ovate, falcate, acute, finely and sharply serrate; ventral suberulent or minutely and closely roughish at tips on both sides, laciniate-ciliate on lower basal margins; dorsal similar in shape, but much smaller and smooth, obtuse and sub-truncate at tips, with finer and more distant serratures, and a ridge or plait running from the lower angle of apex to outer margin of the ventral lobe, basal margin almost entire; cells sub-orbicular, cell-walls thick. Stipule rather large, sub-quadrate-cuneate, narrowest at base, bifid, lobes divergent, each lobe sparingly and coarsely laciniate above, not below, sinus large orbicular. On the stem on each side, within the two lobes, and in their axils, are several small narrow scale-like laciniated processes or leaflets, and also in minute tufts near to the bases of the stipules, but separate and above them.

Hab. In forest, Seventy-mile Bush, County of Waipawa; 1882: *W.C.*

Obs. The exact locality of this peculiar species is at present unknown; the few specimens I have were brought hurriedly away, and merely for comparison, believing them to be identical with other species lately detected there by me. I may, however, find it again.* It is a highly curious species, in its possessing those minute, scale-like leaflets in the axillæ of its leaf-lobes; in this character, however, it is something like *G. nobilis*, Nees, the only other species known to possess it. [But see the following species, recently discovered.]

* Since writing the above, I have again found this plant; June, 1885: its exact locality is in wet low woods, near Norsewood.

5. *G. trichotoma*, sp. nov.

Plant procumbent, spreading, 2–3 inches long, much branched, main branches generally trichotomous at tips; stems leafy, stout, with many brown rootlets at bases, branches about 1 inch long, 4 lines wide, linear, obtuse, slightly rooting at bases; rootlets brown. Leaves a pleasing green, spreading, rather distant below, base of stem bare, close above, oblong-ovate, obtuse, sharply and closely serrate, laciniate-ciliate on basal margins, a ridge or plait running from lower anterior angle of dorsal lobe to the margin of the ventral, with a few other small, scattered, short creases or low plaits on its lamina; dorsal similar in shape and smaller, apices free, bases broadly rounded. Stipule large, quadrifid, segments much laciniate-ciliate: ciliæ long, flexuous, pellucid, jointed (as in *G. chlorophylla*). On the stem, between dorsal and ventral lobes, are two transverse lateral rows of finely laciniated processes or leaflets.

Hab. Among other *Hepaticæ* and mosses on prostrate trees, wet forests near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A fine species, having close affinity with the preceding, *G. heterocolpos*, in its additional stem-leaflets (which, however, are longer, narrower, more numerous, and differently situated), but widely differing in its compound ciliated stipules, etc.

6. *G. chlorophylla*, sp. nov.

Plant very small, under ½ inch long, obovate-oblong, broadest at tip, very obtuse, simple, and 2–4 branched from near base. Leaves closely imbricated, pale green, whitish tipped, oblong, obtuse, margins irregular and sub-laciniate, much ciliated, each lacinia ending in a long cilia; ciliæ all jointed; dorsal lobe similar, but much smaller; cells orbicular. Stipules broadly cuneate, or sub-quadrate-flabelliform, laciniate-lobed, each lobe ending in two large ciliæ: sinus broad.

Hab. On rotten logs, watercourse; deep forest near Norsewood, County of Waipawa; 1883–85: *W.C.*

Obs. A species near to *G. ciliata*, Mitt., but differing in its laciniated stipules and leaves, smaller dorsal lobes, and much smaller size. It has a very hoary appearance on both sides, from its pale colour and long ciliæ. It is apparently scarce, having only very sparingly been met with.

7. *G. bicolor*, sp. nov.

Plant densely gregarious in large patches, simple, broadly obovate, 4–6 lines long, 2 lines broad at tips. Leaves light-green below, bright yellow-green above, sub-imbricate, spreading, sub-falcate, finely laciniate-serrate, especially at tips; dorsal lobes upper margins entire, rounded and broad at base, and overlapping on stem; tips truncate and minutely serrulate; cells sub-quadrate and oblong. Stipules sub-quadrate, bi-lobed

to base, sinus sub-orbicular, lobes laciniate, divergent at base connivent above.

Hab. On rotten logs, dense wet forests near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A small species, having some affinity with *G. lætevirens*, mihi (*supra*), but differing in its leaves and stipules, also in size and colour.

8. *G. pallescens*, sp. nov.

Plant small, scattered, prostrate, simple, and shortly two-branched, broadly obovate, 3–5 lines long, 3 lines broad and much rounded at top, flattish, stems rather stout, with many pink rootlets below, at and near base. Leaves very pale or yellowish-white, close, compact, spreading, sub-ovate-oblong, acute, sub-laciniate-serrate throughout, overlapping at base; dorsal lobes similar, but much smaller, tips somewhat truncate and serrulate; cells orbicular, cell-walls very thick. Stipules very large, sub-quadrate, but broadest at top, bi-lobed (almost quadrifid); sinus open, lobes much laciniate and largely divergent above.

Hab. On rotten logs, among other small *Hepaticæ*; wet shaded woods, Seventy-mile Bush, County of Waipawa; 1883: *W.C.*

Obs. A species near to *G. bicolor*, mihi (*supra*), but differing from it in its larger spreading stipules, and in being much more laciniate, also in colour, form, and habit.

9. *G. marginata*, sp. nov.

Plant prostrate, creeping, simple, sometimes branched below 1–1½ inches long, 4 lines wide, broadest at top, green; stem stout, succulent, with many brown rootlets at base. Leaves close above, distant below, sub-oblong-ovate, rather obtuse, sub-falcate, spreading, laminæ with several small plaits or creases, largely serrate at apex, coarsely laciniate at base; dorsal lobe very broad, rounded, and overlapping below, with the margin entire, or nearly so, truncate and serrate at tip; cells oblong, large, stipules rather large, sub-obovate-quadrate, bifid to middle, each segment once lobed on the outside and laciniate; laciniæ few and rather distant, triangular, acute, not capillary nor ciliate, and all many-celled throughout; cells large; main sinuses orbicular, with their margins thickened as if doubled or bordered. Capsule (immature) cylindrical, narrow-linear, 3 lines long, dark-purple; fruit-stalk sub-clavate at top, but contracted at junction with capsule.

Hab. On trunks of fern-trees, wet shaded forests near Norsewood, County of Waipawa, 1885: *W.C.*

Obs. A species having close affinity with *G. pallescens*, mihi (*supra*).

10. *G. albistipula*, sp. nov.

Plant small, bright light-green; stems sub-erect, simple, 1–1¼ inches long, obovate-oblong, truncate at tip, 4 lines wide in the broadest part, leaved to base; stem stout, succulent, white, with fine filiform rich purple rootlets at base. Leaves thin, closely imbricate, spreading, falcate, ovate-oblong, obtuse (sometimes with a tooth as a mucro), each with 3–4 narrow plaits or creases extending diagonally to margin, the margins of the upper half coarsely serrulate, the lower half of basal margin nearly entire, the upper half of the same laciniate; laciniæ increasing in size towards the stem, and there shortly decurrent; dorsal lobe much broader at base than the ventral, and largely rounded and overlapping the stem, the margin very slightly serrulate and decurved, the apical portion truncate; cells sub-orbicular, rather small. Stipules white, rather large, sub-quadrate, narrowest at base, bi-lobed to middle, sinus large, with two minute laciniæ; lobes broad at top, coarsely laciniate, not ciliate; laciniæ obtuse, celled to apices; cells of various shapes and sizes, mostly orbicular-oblong, large, clear, and double-walled. Fruit-stalk 15 lines long, stout. Capsule narrow, linear-oblong, purple; valves spreading, 2 lines long, linear-lanceolate, very obtuse, not meeting at base, but with a small hemispherical pilose boss in the centre, finely and closely striate longitudinally and transversely with minute dark-brown striæ. Spores orbicular, numerous; no spiral elaters detected.

Hab. On rotten logs and on the earth, forming compact patches in shaded spots; wet woods, near Norsewood, County of Waipawa, 1885: *W.C.*

Obs. A species nearly allied to *G. macroamphigastra*, mihi (*supra*), but differing in its being unbranched, with much less concave leaves, that are also largely plaited, and in its very much smaller and differently-formed white stipules.

** Stipules 0.

11. *G. simplex*, sp. nov.

Plant small, sub-gregarious, simple and sparingly branched, under 1 inch long, 3 lines broad, sub-obovate-linear, very light-green, of a soft texture. Leaves below distant, narrow-oblong, obtuse, and nearly quite entire; the upper not crowded, linear-ovate, slightly and finely serrulate, more so at tips; dorsal small, scarcely half as long as the ventral, sub-elongate-quadrate, upper edge slightly curved, truncate at apices, margins entire; cells small, sub-orbicular; rootlets numerous, long, purple; stipules 0.

Hab. On the ground, among other *Hepaticæ* and mosses; banks of the River Mangatawhaiiti, between Norsewood and Danneverke, County of Waipawa; 1885: *W.C.*

Obs. A curious little naked species, without stipules, and with margins nearly entire, and therefore having affinity with *G. tuloides*, Hook. fil. and Taylor, another New Zealand species formerly discovered by myself; also pretty near to two preceding species (in this paper), *G. læte-virens* and *G. nitida*, from the same forests.

12. *G. ramulosa*, sp. nov.

Plant creeping, prostrate, ascending, stem 1–1½ inches long, 4 lines broad, linear, obtuse, flattish, thickly rooting below on lower part of stem, much branched with several short branchlets at tops. Leaves numerous, and very closely set from base, somewhat inflated, spreading, stem-clasping, pale-green; ventral ovate-oblong, acute and finely serrulate at tips; upper margin rounded, lower nearly straight, both margins entire and slightly recurved; dorsal lobes similar, but much smaller, sharply acuminate at upper angle of tip; cells orbicular, small; stipules 0. Involucral long narrow acuminate and much laciniate-serrate. Fruit-stalk short, shorter than involucral leaves; capsule broadly ovate, red-brown.

Hab. On bark of trees, among other *Hepaticæ* and mosses, spreading in small patches, but apparently very local and scarce; forest between Norsewood and Danneverke, County of Waipawa; 1883: *W.C.*

Obs. A species having some affinity with *G. tuloides*, Hook. fil. and Taylor, and with *G. simplex*, mihi (*supra*), from its not possessing stipules, and its nearly entire leaves.

Genus 9. **Psiloclada**, Mitten.

1. *P. digitata*, sp. nov.

Plant minute, procumbent, very membranaceous. Stems 1–2 inches long, very slender, pinnately branched, with fine rootlets at tips. Leaves pale-green, microscopical, rather close set, sub-quadrate in outline, patent, those on main branches much broader than their stems, 3–4 lobed, the blade as long as or longer than the lobes, and appearing as if 5–7 nerved; lobes subulate, spreading, with the apparent "nerves" continued into them; cells large, regular, oblong or sub-quadrate, extending to tips of lobes. Stipules similar, but much smaller and adpressed. Fruit, etc., not seen.

Hab. Damp shady woods, among other *Hepaticæ* and mosses, near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. The cells of this little plant somewhat resemble those of *Lepidozia patentissima*, only they are more regularly disposed in lines among the apparent "nerves." Some of the long capillary branchlets have also the appearance of fine rootlets at their tips, as in some *Lepidozia*. The 4-lobed leaves, with their

dark and straight lines of "nerves," bear a close resemblance to the back of a gloved hand. It is a beautiful little plant, having a strong resemblance in habit, form, and texture to the only other (known) species, *P. clandestina*, Mitt.; but, from the absence of fruit, it is somewhat doubtful as to genus. At present the plant is scarce, only two specimens having been detected; from its minuteness, however, it is easily overlooked.

Genus 13. **Lepidozia,** Nees.

1. *L. concinna*, sp. nov.

Plant largely and loosely tufted, branched, procumbent, overlapping, pale-green, 2–3-pinnate; branches 1–2 inches long, 4–5 lines wide, sub-oblong-lanceolate; branchlets 2–2½ lines long, widely apart, alternate, decurved, the shorter ones broad and rounded, and the longer ones capillary at tips. Leaves many, closely set and sub-imbricate on branchlets, more distant on main stems, patent, slightly incurved, sub-quadrate, 3–4-fid; cells strongly defined and numerous, large in the centre at base of leaf. Stipules small, quadrate, 4-cleft to middle, patent; segments subulate, acute, spreading, sinus wide, round at base; cells of segments in 3–4 rows, very minute, distinct, regular.

Hab. On living trees, forming thick and large patches; wet forests near Norsewood, County of Waipawa, 1885: *W.C.*

Obs. An elegant species, allied to two of the known New Zealand ones, *L. microphylla*, and *L. pendulina*, Lind.; also to the following one, *L. cancellata*, mihi; and also to *L. chordulifera*, Tayl., a species of the Chonos Archipelago. The leaves in shape and in cell-areolæ are somewhat like those of *L. procera*, Mitt., a Tasmanian species, but the plant is widely different.

2. *L. cancellata*, sp. nov.

Plant largely and loosely tufted, of a pleasing green; branches 1½ inches long, 3 lines broad, linear-lanceolate, rarely branched at base, sub-procumbent, loosely overlapping, bi-pinnate; branchlets numerous, alternate, rather closely set, short, 1–1½ lines long, very rarely again branched, tips sometimes capillary, and then exceedingly fine and reddish. Leaves large, sub-oblong-quadrate, 4-fid, cancellate, very close, incurved (presenting a sub-verticillate appearance), those on the main stem more distant and very large; cells large; segments very long, curved and spreading, subulate, acute, each with a single row of cells; sinus large, round. Stipules similar but smaller, distant, patent.

Hab. On trees and logs, forming large and thick patches; forests near Norsewood, County of Waipawa, 1885: *W.C.*

Obs. A species very near the preceding (*L. concinna*, mihi), but differing in its more slender and simple branches; in its

shorter and closer branchlets that are rarely capillary, and when so, finer than fine hair and coloured; in its larger leaves with larger open cells visible to the naked eye, and in their much longer segments which are also in single-celled rows throughout. A truly elegant plant.

3. *L. subverticillata*, sp. nov.

Plant small filiform procumbent spreading, closely adhering to rotten wood, much and irregularly branched; light-green. Main branches 2 inches long and more, sub-bi-pinnate, narrow, linear-oblong; branchlets short, alternate, tips occasionally but seldom capillary. Leaves highly cellular, close set, overlapping (having a sub-verticillate appearance), sub-oblong-quadrate, 3- (sometimes 4-) fid; lamina very short, scarcely any; segments very long, articulate, incurved. Stipules similar, but smaller and more distant. Perianth terminal on short lateral branchlets (sometimes two close together), very large for the plant, cylindrical, 2 lines long, vertical, largely ciliate at tips with 6–9 long flexuous ciliæ; cells large, narrow-oblong; involucral leaves large, cellular, sub-broadly-ovate, tips slightly laciniate.

Hab. On rotten logs, forming small thick patches; in wet forests near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A very neat little species of a pleasing green colour; its affinities are with *L. capillaris*, Lind.

4. *L. minuta*, sp. nov.

Plant minute, prostrate and creeping, wiry, irregularly branched, pale-green, with long white capillary pellucid radicles below. Main branches about 1 inch long, with many capillary branchlets $\frac{1}{2}-\frac{3}{4}$ inch long. Leaves rather small, close set, and sub-imbricate, patent, quadrate, 4-dentate, larger and more distant on the main branches; lamina large; teeth short, broadly-triangular, acute, incurved; cells small, sub-orbicular, distinct, much larger in the centre of leaf. Stipules minute, distant, similar to leaves but much smaller, 3–4-toothed. Perianth lateral, sub-sessile on main stems; involucral leaves rather large, oblong-ovate, slightly laciniate; cells large.

Hab. Among mosses and small *Hepaticæ*, on decaying logs; wet woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species having close affinity with *L. lævifolia*, Lind.

Genus 14. **Mastigobryum**, Nees.

1. *M. concinnatum*, sp. nov.

Plant a pleasing light-green, densely and regularly tufted, shortly creeping, imbricate; stems $\frac{3}{4}-1\frac{1}{2}$ inches long, dichotomous; branches $\frac{1}{2}$ inch long, linear, $1\frac{1}{2}$ lines wide, obtuse, divergent, sending down long scaly and hairy rootlets; young branches and rootlets highly cellular. Leaves close, distichous,

spreading, imbricate at base, flat, falcate, sub-ovate-oblong, truncate, 3-toothed; teeth acute; dorsal margin curved, ventral straight; cells orbicular, small and distinct at apex, larger and very compact at base; young leaves with compact sub-quadrate cells. Stipules rather large, free, sub-quadrate, usually 6- (sometimes 4- and 8-) toothed; teeth small, blunt; cells smaller than in leaves and more distinct (very much like those of *M. novæ-zealandiæ*, Mitt.). Fruit not seen.

Hab. Forests near Norsewood, closely overlying mosses (particularly tufts of *Leucobryum candidum*, and killing them); 1885: *W.C.*

Obs. A very pretty species, having affinity with *M. taylorianum*, Mitt., and *M. monilinerve*, Nees.

2. *M delicatulum*, sp. nov.

Plant small, procumbent, creeping; stems ½ – 1½ inches long, less (with leaves) than ½ line wide, dichotomous, having a jointed appearance. Leaves minute, pinnate, pale-green, somewhat thickish and opaque, free, rarely laxly imbricate, slightly convex, obliquely oblong-quadrate, sub-falcate, spreading, truncate at tips and coarsely 3-dentate, dorsal margin arched, ventral straight; cells minute, annular, distinct in parallel lines alike throughout (much as in *M. novæ-zealandiæ*). Stipules free, small, very membranaceous, light-reddish-brown, sub-quadrate, 3–5-fid; segments straight or slightly curved; cells large. Flagellæ few and short. Fruit not seen.

Hab. On trunks of tree-ferns, shaded wet woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs.—A peculiar finely-cut soft and delicate-looking plant, forming close and thickish patches through continuously overgrowing; having pretty close affinity with *M. taylorianum*, but differing in its free leaves with orbicular separate cells that are alike throughout, and in its quadrate laciniate membranaceous stipules. I have not yet found it in fruit; and for a long time I had supposed it might prove to be a species of *Lophocolea*, owing to its being barren and my not meeting with a single imbricating branchlet.

3. *M. quadratum*, sp. nov.

Plant small, tufted, sub-erect; stems ¾ – 1 inch long, once forked, and loosely dichotomously branched; grass-green. Leaves close, laxly imbricate at bases, pinnate, falcate, sub-oblong-quadrate, broadest at base, lateral margins slightly uneven or sub-sinuate-dentate, the upper one much arched, the lower straight, short, tip truncate and 3-dentate; teeth large, acute, cellular; cells small, orbicular, larger and oblong-orbicular in centre of leaf. Stipules free, large, quadrate, emarginate, toothed on three sides but most so at top, reddish-tipped. Flagellæ numerous, slender, short.

Hab. Among mosses, etc., on prostrate rotten trunks, damp woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species having pretty close affinity with the two preceding, and presenting a similar appearance; but widely differing in form of stipules, etc.

4. *M. fugax*, sp. nov.

Plant small, 1–2 inches long; stems procumbent and sub-erect, straggling, much branched; branches rather distant, long, filiform, few-leaved, naked below. Leaves alternate, obliquely oblong, broadest at base, amplexicaul, $\frac{1}{36}$th of an inch long, entire, tip broad, very obtuse (sometimes slightly retuse and sub-sinuate), upper margin much arched and very slightly imbricating towards base, the lower straight; pale-green; very fugacious. Cells small, orbicular, with a central longitudinal band of larger ones, increasing in size from apex to near base. Stipules very minute, free, sub-palmate, 4-laciniate; nearly all laciniæ subulate and highly cellular.

Hab. On bark of living trees, among other small *Hepaticæ;* wet woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A small wiry-looking species, having affinity with *M. convexum*, Lind., a Cape of Good Hope species, and also approaching *M. australe*, Lind., a Fijian species. It has rather a ragged look, especially when compared living with the three foregoing New Zealand species; mainly through the easy falling-off of its leaves, which happens with the most careful handling, probably owing to their excessive thinness from the large cells at their bases.

5. *M. similis*, sp. nov.

Small, stems about 1 inch long, dichotomous; branchlets short, divergent. Leaves pale-green, somewhat distant, rarely overlapping at base, flat, spreading, obliquely oblong-quadrate, 3- (sometimes 2-) dentate, teeth short, obtuse; dorsal margin much arched, broad and rounded at base, irregularly sinuate towards apex; ventral margin slightly irregularly sinuate; cells small, confused, with a band of larger ones running from base towards apex within the ventral margin. Stipules free, small, sub-quadrate, 4-fid, largely cellular; segments very long and capillary.

Hab. Forests near Norsewood, County of Waipawa; among other small *Hepaticæ;* 1885; W.C.

Obs. A species having close affinity with *M. taylorianum*, Mitt., but differing in its leaves being distant and much broader at their bases, with sub-sinuate margins, and obtuse and short apical teeth, and also in its stipules being sub-quadrate and largely laciniate, with long cellular capillary segments. Only a few broken specimens were found, mixed among other *Hepaticæ*,

Genus 24. **Fossombronia**, Raddi.

1. *F. rosulata*, sp. nov.

Plant very small, gregarious, creeping at roots, and forming minute mounds, rising in little separate erect rosulate heads very close together, 1½–2 lines high, and about the same in diameter; stem 0; rootlets numerous, purple, matted. Leaves compact, semi-orbicular, sessile, much waved and crumpled, sub-papillose, margins entire, yellowish-green; cells large, broadly-oblong. Perianth very similar, but much smaller, margins slightly and distantly crenate; marginal cells minute, orbicular. Fruit-stalk stout, erect, 5 lines long. Capsule globular, rather large, reddish-brown, minutely reticulately veined, and sub-papillose on the outside, bursting very irregularly.

Hab. Among other *Hepaticæ* and mosses on damp, shaded, clayey cuttings; sides of highway, near the bridge over the River Mangatawhainuī, Seventy-mile Bush, County of Waipawa; 1880–85: *W.C.*

Obs. A very minute plant, nearly allied to the other two published New Zealand species, *F. pusilla*, Nees, and *F. intestinalis*, Tayl.; and also, though more distinctly, to *F. nigricaulis*, mihi (*infra*). It has been long known to me in a barren state, and although often sought in a fruitful one, has only during the summer of 1884–85 been detected bearing fruit.

2. *F. nigricaulis*, sp. nov.

Plant procumbent, creeping, 1–1½ inches long, linear, obtuse, largest specimens 3–4 lines broad at top, shortly branched, branches and tips ascending. Stems stout, dark-brownish-black, densely clothed below with thickish dark-red roots. Leaves pale-green, thin, sub-papillose, broadly oblong, somewhat sub-quadrate at apices, much waved and crumpled, those below a little apart and very decurrent on upper side of stem, giving it a sub-pinnatifid appearance, those at tips crowded, margins thin, entire; cells large, oblong. Involucral similar but smaller, extending (rosulate) around stem and base of fruit-stalk; cells very large. Fruit-stalk 4–6 lines long; capsule globular, reddish-brown, bursting irregularly; sometimes two together, or near each other on top of stem.

Hab. Cliffy sides of road, near the River Mangatawhainui, Norsewood, County of Waipawa; 1884–85; *W.C.*

Genus 25. **Noteroclada**, Taylor.

1. (?) *N. lacunosa*, sp. nov.

Plant prostrate, appressed, spreading, branched; rootlets small, many, closely adhering to the soil; branches 1–2 inches long, 8–10 lines broad, pinnatifid, midrib stout but obscure sub-succulent, brittle, glabrous; colour a pleasing dark grass-green.

Lobes large, 4–5 lines long, 2–3 lines wide, nerveless, not extending to midrib, very close and sub-imbricate, sub-orbicular and broadly elliptic, thin, transparent, finely papillose, studded with pale yellow dots, most so on basal margins; margins entire; the large apical portion of the lobe smooth, flat, and spreading laterally, the basal portion concave with margins raised above midrib, sub-erect, and transversely corrugated almost regularly, thickened and recurved, and having a deeply lacunose appearance; in each posterior axil of those lower cavities on the upper surface is a small cluster of reddish-tipped antheridia (immature) with green paraphyses intermixed. Cells of lobes numerous, large, irregular sizes, sub-quadrangular.

Hab. Scattered in small patches on wet shaded banks, sides of streams and watercourses, among other *Hepaticæ;* low woods, Seventy-mile Bush, County of Waipawa, 1880–85: *W.C.*

Obs. This is a very striking plant, resembling no other known to me among all our numerous endemic plants of this order. Its large size, remarkable fresh and regular semi-ribbed appearance, and dark colour, arrests the eye at once. It has caused me "a world of trouble," extending over several years, in my endeavouring to obtain it in fruit; hitherto, however, I have failed, although I have diligently visited its marked habitats at all seasons of the year, save mid-winter, when I suspect it bears fruit. Not having detected it in fruit, I am not certain of its proper genus; but of all the known genera of *Hepaticæ* this plant is more closely allied to *Noteroclada*, in which I have provisionally placed it; also, though more distantly, to *Fossombronia*, a cognate genus; from which genus, however, its round leaves or lobes exclude it. It is by no means plentiful, only occurring here and there and at distant spots in single small patches, but always presenting a uniform healthy, strong, flourishing appearance. Having sought it so long and so frequently in the fruiting state, without success, I now make it known in its barren form.

Genus 26. **Petalophyllum**, Gottsche.

1. *P. macrocalyx*, sp. nov.

Plant gregarious, minute, 2–3 lines diameter, 1–2 lines high; stem stout, very short scarcely any, dark-red-black, with many fine short red spreading rootlets. Leaves few, sub-rotund, waved and crumpled, margins entire; cells large, sub-quadrate. Perianth large, sub-campanulate, erect, 2 lines long, 1¼ lines broad, whitish, margin entire. Fruit-stalk 12–14 lines long, slender, capsule globular, brown, splitting irregularly into four divisions, each sub-cuneate, obtuse, 2–3 lobed.

Hab. Among mosses and small frondose *Hepaticæ*, damp sides perpendicular cuttings on the roadside, Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A very minute plant, wholly hidden but for its large erect inflated whitish perianth.

Genus 27. **Zoopsis**, Hook. fil. and Tayl.

1. *Z. flagelliforme*, sp. nov.

Plant slender, prostrate, glabrous, glistening, light-green; $\frac{3}{4}$ – $1\frac{1}{2}$ inches long, $\frac{1}{40}$th of an inch broad, much and dichotomously branched; main branches linear-lanceolate, flexuous, composed of two rows of cells on each side of the central cord, tips flagellate; sides sinuate with sub-rotund or knobbed projections of large blunt cells, sub 3, or so, together, alternate and at almost regular distances, with smaller cells intervening, and a few scattered short and simple rootlets beneath peeping. Involucral scales long, irregular, lanceolate. Perianth large, lateral, pedicelled, highly cellular, almost cancellate, much laciniate; laciniæ long, each composed of two rows of large orbicular cells; also some of a single row of oblong cells; pedicel thick. Fruit-stalk 2 lines long, septate, cellules large and full of scattered dark dots; capsule light brown, oblong; valves oblong-lanceolate, obtuse, excessively reticulated with dark veins, the longitudinal ones thick and wavy.

Hab. Among other *Hepaticæ* on decaying logs; wet forests, Norsewood, County of Waipawa; 1885: *W.C.* (Same localities; October, 1885: *W.C.*

Obs. A species having pretty close affinity with the only other known (published) species of this genus, *Z. argentea*, Hook. fil. and Tayl., but differing from that species in its larger size yet narrower; in being much branched, with flagellate tips; in shape, and in colour, and in the number, form, and position of its cells. A truly elegant object under a misroscope.

2. (?) *Z. lobulata*, sp. nov.

Plant minute, tufted, glabrous, stems brownish, creeping, 3–4 lines long, dichotomous, sub-bipinnatifid; branchlets or lobes sub-erect, linear, almost filiform, about 1 line high, emarginate, margins entire; cells sub-orbicular, apparently 2–3 nerved; light-green. Perianth lateral near base, short, laciniate, thickish, opaque, brownish-red. Calyptra sessile, sub-obovate, very membranaceous, reticulate, bearing a small reddish cellular boss or umbo on the top, which is persistent. Capsule shortly pedicelled, oblong, on a short, thickened, linear-oblong (or apophysate) stem, striate, bursting at tip, mouth conniving. Spores green, orbicular, trilobed. Elaters long, pointed and spiral, remaining fixed in an irregularly pencilled mass at mouth.

Hab. On denuded rotten logs, in large continuous patches; shaded wet forests, near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. It is with some doubt that I place this new, curious, and interesting little plant under *Zoopsis*, as it possesses some only of its characters. Sir J. D. Hooker had only seen "immature fruit" of the one species on which he established that genus. This plant, however, is very distinct from that one, and also from *Z. flagelliforme*, mihi (*supra*), and may yet become the type of another genus.

Genus 30. **Symphyogyna**, Mont. and Nees.

1. *S. brevicaulis*, sp. nov.

Plant epiphytical, closely gregarious, pendulous and imbricated in growth, rhizome creeping, rough, spongy, light-brown, villous. Frond light grass-green, glabrous, mostly simple, linear-oblong, about ½ inch long, 1–2 lines wide, sometimes but rarely forked, much waved, margins entire, tips retuse, broad at base and shortly decurrent or truncate, midrib thick; stipe very short, with fine red hairy rootlets at base; cells large, of various sizes, sub-quadrate. Involucre central, sometimes 2–3 on a single frond, and when the frond is forked not at the forking, small, deeply laciniate, laciniæ very narrow. Calyptra long, tubular, sub-clavate, striate, rather loose and sub-plaited, lips entire, bearing a few scattered reddish pistillidia. Fruit-stalk short, often two very near each other. Capsule 1 line long, cylindric, obtuse, finely striate, purple-black; spores circular, dark purple-brown; elaters very numerous, long, bi-spiral, flexuous.

Hab. Clothing the stem of a fern tree (*Dicksonia squarrosa*), in a deep-shaded forest near Norsewood, County of Waipawa; 1884–85: *W.C.*

Obs. A species near to *S. sub-simplex*, Mitten, and to *S. simplex*, Colenso, ("Trans. N.Z. Inst.," vol. xvi., p. 352,) especially in its barren fronds, but very distinct in its characters.

Genus 32. **Aneura**, Dumort.

1. *A. muscoides*, sp. nov.

Plant light-green, in dense, small-moss-like effigurate subcircular patches, 5–6 inches diameter; excessively compact and uniform. Fronds minute, erect, sub ½ inch high, simple, rarely forked, compressed, linear-cuneate, under ½ line wide, broadest at tip, margins sinuate, and very shortly and sparingly lobed or knobbed; tip 1–2 notched, or truncate; green above at apex, white below at base.

Hab. Sides of wet cliffs, and closely adhering to them; River Mangatawhainui, near Norsewood, County of Waipawa; October, 1884: *W.C.*

Obs. This little plant wears a most peculiar appearance, more like a thick patch of densely growing *Conferva*, or a piece of green plush cloth! Although presenting such a close rigid

aspect, and when gathered with unbroken base it adheres closely together, yet on the basis being cut it falls directly into separate fibrils or fronds. Growing with it and scattered among it, and just as closely compacted and regular in height, is another small *Hepatica*, *Gymnomitrium orbiculata*, mihi (*supra*).

2. *A. pellucida*, sp. nov.

Plant low, creeping, forming large, compact, small-moss-like patches on branches of living trees, densely imbricate, regular in height and in general appearance, 3–4 lines high, bi-tri-pinnatifid, rather thickish, succulent, very fragile, bright emerald-green, shining; main branches concealed, flat, broad, adhering strongly by many minute rootlets; branchlets opposite, sub-erect, sub-palmate, many lobed; lobes short, broadly linear, entire, obtuse and emarginate, the broadest minutely crenulate at tip, sub-pellucid; cells large, sub-orbicular, very close, apparently disposed in a double layer and beaded. Calyptra cylindrical, 1½ lines long, white, transparent, rugose; cells large and oblong, also having a beaded appearance. Seta very slender, weak, hyaline, shining, ½ inch long. Capsule, valves linear, acute, spreading, finely striate longitudinally; pencils of elaters at tips patent with a sub-rigid appearance, bi-spiral, acicular at tips.

Hab. On branches of living trees; wet shady woods, near Norsewood, County of Waipawa; 1876–1885: *W.C.*

Obs. A small, low, spreading, mossy-looking plant of a lively green colour, not unfrequently met with on the branches of the smaller forest trees with smooth bark, (as *Melicytus*, the larger species of *Coprosma*, *Weinmannia*, etc.,) in wet shaded woods, but rarely ever found in fruit. Indeed, I never detected any fruiting specimens until this autumn (April, 1885). It is altogether a charming object under a miscroscope from its transparency, the apparent regularity of its growth, in the length, height, and direction of its minute fronds, (all, too, severally more or less irregular,) is very remarkable. It has close natural affinity with the following species, *A. crispa*.

3. *A. crispa*, sp. nov.

Plant prostrate, spreading in effuse dense patches, 4–5 inches long; 2–3 pinnatifid, closely imbricate, dark-green. Fronds or lobes about ¼ inch high, sub-erect, ascending, much cut and irregularly laciniate; calyptra white, sub-clavate, tubercled, erect and curved, 2 lines long, rising above the plant, and so presenting a novel appearance; fruit-stalk very slender; capsule rather long, linear-oblong; valves narrow, bearing elaters largely at their tips.

Hab. On rotten logs, shaded and damp spots, base of high cliffs, banks of River Mangatawhainui, near Norsewood, County of Waipawa; October, 1884: *W.C.*

4. *A. epibrya*, sp. nov.

Plant thickish, brittle, softish, light-green, mostly composed of single irregular-shaped sub-erect fronds, that are sometimes forked and slightly branched or lobed, and sometimes overlapping, 1–1½ inches long, 3–4 lines wide, broken below, arising from a decaying base. Fronds sub-solitary, linear-oblong, expanded and rounded at tips, waved, rumpled, and incurved, margins entire, thin, slightly and irregularly crenulate, usually more so at tips; semi-transparent when fresh, largely so when dried, with short, yellow, silky hyaline rootlets below, by which it adheres strongly to its supporting moss; cells obscure. Calyptra stout, erect, 3½ lines long, green, bristly and rough, with short patent hairs.

Hab. Epiphytical on *Hypnum aciculare*, dry shaded declivities, *Fagus* forests near Norsewood, County of Waipawa; 1883–85: *W.C.*

Obs. A peculiar species, confined (as far as I have observed) to this one species of large, erect and very dry moss, which it sometimes kills; its fronds are of vigorous growth, but are almost invariably rotten at their bases. In its strange habitat (for a plant of this genus that delights in low, wet and shaded localities,) it is plentiful, though always scattered, from its so early decaying at base. It is allied to *A. biflora*, Col.,* which species is also epiphytical on living moss (*Hookeria*), but that moss is only found in wet, dark shaded localities, and is also sub-succulent.

5. *A. marginata*, sp. nov.

Plant small; main stems creeping, prostrate, dark red-brown; branches generally simple, sometimes forked, erect, densely tufted, 3–4 lines high, linear, sub-clavate, occasionally somewhat palmate, margined; margins entire, sometimes (but rarely) slightly denticulate and sub-lobed, tips emarginate; succulent, sub-rigid; green. Cells large, sub-orbicular, sparsely beaded, those of margin small and very regular. Fruit single at base of lobe below. Calyptra cylindrical, erect, 1½ lines long, sparingly tubercled below, more so above, and crowned with a boss of tubercles; tubercles red, obtuse, cellular. Capsule oblong, dark-blue.

Hab. On rotten logs in low wet woods, forming close and large patches; forests near Norsewood, County of Waipawa; 1885: *W.C.*

6. *A. nitida*, sp. nov.

Plant minute, creeping, imbricate, reclinate, densely tufted, crisp and brittle, of irregular growth; yellowish-white. Base stems, or main branch of frond, broad, flat, strongly adhering,

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* *Vide* "Trans. N.Z. Inst.," vol. xvii., p. 262.

glistening, having a varnished appearance; branches very short, broad, irregular, sub-flabellate, laciniate and deeply lobed; lobes about 1 line long, sub-erect, secund, linear, entire, sometimes slightly sub-denticulate, spreading; tips obtuse. Cells rather large, oblong, numerously beaded. Fruit-stalk lateral at sinus of lobes, single, sometimes 2–4 on a branchlet; involucral scales 2–4, small, broad, acute and spreading. Calyptra white, slender, 1 line long, very sparsely tubercled throughout; tubercles very fine almost hairs, white. Capsule very narrow, linear-oblong, slender.

Hab. In low wet woods near Norsewood, County of Waipawa; 1885: *W.C.* On rotten logs forming large yellow patches, adhering very strongly as if gummed on; difficult to separate even when long steeped in water.

Obs. A species similar to the preceding, *A. marginata*, but differing in colour, habit of growth, not being margined, cells oblong and confused; calyptra white, more slender, and not coarsely and red tubercled; and the main stems broad, flat, and glassy.

7. *A. punctata*, sp. nov.

Frond small, greenish-white, thickish, sub-erect, 3–6 lines high, effuse, usually somewhat broadly palmate, spreading, much branched and lobed; branches very short, sub-pinnatifid or lobed, retuse, irregular; cells oblong, large. Calyptra erect, 1 line long, cylindrical, sub-clavate, contracted at mouth, white, smooth, cellular, sub-transparent; cells linear-oblong, minutely beaded with round dark dots. Fruit-stalk slender, $\frac{1}{2}$ inch long, hyaline, transversely septate. Capsule rather small, oblong, dark purple-brown, finely striate, closely and minutely transversely barred or dotted with black, valves obtuse, margined; elaters long, bi-spiral with acute tips; spores circular.

Hab. Among other *Hepaticæ* on rotten logs, forming thick little patches, wet woods near Norsewood, County of Waipawa; 1885: *W.C.*

Genus 39. **Anthoceros**, Micheli.

1. *A. granulata*, sp. nov.

Plant prostrate, spreading in effuse patches, 5–6 inches long, closely adhering by its numerous fine hair-like rootlets, densely imbricate, light-green, and covered with masses of fine sparkling granules, as if frosted (or like soredia in some species of *Parmelia*); lobes at first very small and irregular, large and concave in age, with rounded crenulate margins. Calyptra conical, thick and sub-globose at base, and slightly tubercled; peduncle $\frac{1}{2}$ – $\frac{3}{4}$ inch long, erect, green; capsule $\frac{3}{4}$ inch long, dehiscing to base at one side only, brown; valves flexuous, broad and flat; columella very slender.

Hab. On rotten logs, growing with *Aneura crispa* (*ante*), shady bases of cliffs, River Mangatawhainui, near Norsewood, County of Waipawa; November, 1884: *W.C.*

Obs. Before fruiting the fronds are very soft, and are then easily mistaken for some other allied frondose genus of *Hepaticæ.*

2. *A. membranaceus*, sp. nov.

Plant prostrate, spreading in small irregular patches, sub-imbricate, green. Lobes variously shaped, mostly obovate-oblong, 4–8 lines long, sub-pinnatifid; lobules rounded very much and finely cut (sub-laciniate-fimbriate), very thin, abounding in reticulate cells under a lens. Calyptra conical, roughish, green below, brownish at tip, 3 lines long; peduncle slender, green, 6–8 lines long; capsule about ½ inch long, very slender, light-brown, diverging at tips; valves separate to base; columella very filiform, flexuous; spores orbicular, muricated; elaters flexuous, bi-spiral.

Hab. On logs in wet dark woods, near Norsewood, County of Waipawa, growing underneath large *Aneura*, &c.; November, 1884: *W.C.*

Obs. A species remarkable for the smallness of its fronds, and the number of its fruit-stalks, the fine hair-like slenderness of its receptacle, and the light-red colour of its capsule.

3. *A. pusilla*, sp. nov.

Plant very small, densely gregarious in effuse patches of 3–4 inches, erect, glabrous. Fronds 3–4 lines high, 2–2½ lines wide at top, broadly cuneate and sub-fan-shaped, lobed, laciniate; upper margin crenulate and crisped, thickish, succulent, pellucid; apical portion light-green; pale below, covered with scattered minute green specks, and a few small white rootlets near the base; cells large. Calyptræ 1–2–3 on a frond, rising from the centre, cylindrical, 2 lines long, bulbous at base, smooth, entire at margins; capsule 3–4 lines long, slender, green; tips black. Gemmæ scattered in substance of frond, in rather large dark coloured elliptic bodies.

Hab. Among mosses and *Hepaticæ*, bases, wet sides of steep clayey cuttings, public roads; Seventy-mile Bush, County of Waipawa, 1885: *W.C.*

Obs. A species having some affinity with *A. muscoides*, mihi ("Trans. N.Z Inst.," vol. xvi., p. 361), but smaller, with fewer and very much shorter capsules, etc.

"Qui quo destinavit vult, unam sequatur viam, non per multas vagetur.—Non ire istud, sed errare est." (SENECA, *Epist.* xlv.)

Art. XLIV.—*A Description of some newly-discovered and rare Indigenous Plants: being a further Contribution towards the making known the Botany of New Zealand.* By W. Colenso, F.L.S., etc.

[*Read before the Hawke's Bay Philosophical Institute*, 14*th December*, 1885.]

Class I. Dicotyledons.

Order I.* RANUNCULACEÆ.

Genus 3. **Ranunculus,** Linn.

1. *R. ruahinicus*, sp. nov.

Erect, stout, 2 feet high, paniculately branched, many flowered, thickly pilosely-villous, light-green with a yellowish tinge; hairs mostly short, pale reddish-brown. Leaves orbicular, $4\frac{1}{2}-5\frac{1}{2}$ inches broad, coriaceous, upper surface slightly hairy, with long strigillose hairs; under surface much more hairy, the hairs shorter, and springing singly from pits or minute depressions in the lamina, but long and thick on the veins; 10–12 ribbed, ribs extending to margin, stout, prominent below; much reticulately veined; margins crenately-serrate (usually 1 broad crenature and 1 smaller and more acute one), each with a small dark-brown raised point or knob at the apex end of a vein; sparingly sub-lobed, lobes 3–4 lines deep and over-lapping; edges thickly ciliate; sinus broad diverging; petiole stout, 4–5 inches long, 3 lines wide, hairy like under-surface of leaf, sheathing at base with a pair of broad membranous stipules. Peduncle stout, 2 lines wide, cylindrical, fistular, with a whorl of three cauline linear-lanceolate sessile bracts, $1\frac{1}{2}$ inches long, 4 lines wide, 3-nerved, thickish, with a few scattered hairs on the upper surface, margins entire and much ciliate; pedicels 4, sub-fasciculate, each 4 inches long, sub-angular, bi-bracteolate about the middle; bracts sessile, linear, 8–9 lines long, diverging. Flowers bright glossy yellow (rather pale, not dark) on the face, paler and dull, with a tinge of green, on the back; $1\frac{1}{4}-1\frac{1}{2}$ inches diameter. Sepals 5 (similar in colour to the petals on the back), broadly ovate, $\frac{1}{2}$ inch long, very concave, hairy, strongly and coarsely veined, almost ribbed; 3 principal veins at base soon branching into 8–9 longitudinal ones; tip thickened obtuse emarginate green; margins very thin and largely ciliate. Petals (always) 5, large, broadly cuneate, with scarcely any claw; 7 lines wide at top and about 8 lines long, spreading, wavy, margins reflexed, emarginate, obsoletely nerved (nerves prominent in dried specimens), with one broad stout glandular depression having a ridged margin close to base. Anthers very

* The numbers in this paper attached to both Orders and genera, are those of the "Handbook of the New Zealand Flora."

numerous, rather small, elliptic, obtuse, with a minute connective; stamens somewhat clavate, or with the anther subspathulate. Heads small, broadly ovate; receptacle elongated, glabrous, finely papillose. Achenes (immature) long, narrow, subulate, erect, slightly hairy below; style scarcely recurved, glabrous; tip (stigma) minutely pencilled.

Hab. On spurs of the east slopes of the Ruahine mountain range, County of Waipawa; November, 1885: *Mr. H. Hill.*

Obs. A fine and striking species, but closely allied to *R. insignis*, Hook. fil.; differing, however, in its smaller size; orbicular strigillose leaves; larger, ribbed, and ciliated sepals; fewer, deeply emarginate, broader and rumpled petals; and especially in their possessing but a *single* glandular depression—*R. insignis* having more (2, "Flora N.Z.;" 3,* "Handbook" ditto); on which grave characteristic stress is also laid—and also in the form and construction of the anthers. It is, however, worthy of note, that *R. insignis* is a denizen of the higher summits of this mountain range (where it was originally discovered by me), while this plant is found on the lower spurs of the same range.

Order VI. CARYOPHYLLEÆ.

Genus 2. **Stellaria**, Linn.

1. *S. oligosperma*, sp. nov.

A slender prostrate rambling flaccid creeping and glabrous herb, 1 foot or more long, growing in pretty large entangled patches of many feet, rooting from its nodes. Leaves few, distant, opposite in pairs, very thin, light-green, orbicular, 2–2½ lines diameter, with intra-marginal parallel vein, apiculate, petioles slender, longer than leaves, with a few weak hairs. Peduncles axillary, much longer than leaves, patent, two-flowered; pedicels 4–6 lines long, unequal in length though springing from the same base, erect and divergent at right angles with a pair of bracts at their base, and another pair below the middle of the longer pedicel; bracts ovate-acuminate, scarious with a dark central line. Flowers 1½ lines diameter; sepals 5, ovate-acuminate, 1-nerved with white scarious margins; petals 5 divided to base, each lobe linear-spathulate; stamens usually 9; styles 3, large, flexuous; capsule twice the length of sepals, very membranous, white, 6-valved nearly to base, valves reflexed; seeds few and large, usually 6, sometimes fewer, orbicular, turgid, with a notch, bright cinnamon-coloured when first ripe, becoming dark-brown with age, finely and regularly marked somewhat concentrically, not pitted.

* Can this "3" be an overlooked "printer's error"? as two only are shown in the admirable plate in "Flora Novæ Zelandiæ," and also twice repeated in the description.

Hab. In shaded forests, near Norsewood, County of Waipawa; 1883–85: *W.C.*

Obs. A species having pretty close affinity with *S. parviflora*, Banks and Sol., which it resembles in habit, but differing in several particulars.

Order XVII. STACKHOUSIEÆ.

Genus 1. **Stackhousia**, Smith.

1. *S. uniflora*, sp. nov.

Plant small, glabrous; stems creeping underground; branchlets numerous, slender, sub-angular, erect, loosely branched, light-green, with reddish striate lines, 1–2 inches high; leaves small, few, distant, 6–10 on a main branch, linear-obovate and broadly-lanceolate, 1½–2½ lines long, acute and sub-apiculate, thickish, nerveless, green with reddish margins, sub-petiolate with minute stipellæ. Flowers terminal, solitary, conspicuous, rather large for the plant, peduncled with one small foliaceous bract at base; calyx lobes adpressed, deltoid, serrulate and very acute; corolla 2–2½ lines long, yellowish-brown, speckled and striped with red (as also the calyx), tube united nearly to base, lobes more dusky and dark spotted, linear-lanceolate, acute, 1 line long, spreading, sub-revolute; anthers glabrous, oblong, sub-acute, cordate, orange; stigma trifid; cocci (immature) 3.

Hab. On open spots, banks of the River Manawatu, County of Waipawa; November, 1884: *Mr. Henry Hill.*

Obs. A species allied to *S. minima*, Hook. fil., our only known New Zealand species, but differing from it in its flowers being always solitary, its adpressed calyx with serrulate lobes, and its glabrous anthers. It is also closely allied to *S. pulvinaris*, Muell., (judging from Bentham's description of that species in his "Flora Australiensis,") an Australian and Tasmanian plant of nearly the same size and habit; which species, however, has crowded leaves almost concealing the flowers, obtuse lobes to the corolla, and small obtuse bracts.

Order XVIII. RHAMNEÆ.

Genus 1. **Pomaderris**, Labill.

1. *P. amœna*, sp. nov.

Shrub 2–3 feet high, bushy, diffused, much branched, very leafy; stems and branches dark-red-brown; branchlets thickly hirsute-pubescent with patent grey hairs. Leaves numerous, close set, thickish, patent, sub-decurved, 2–3 lines long, linear, obtuse, wholly revolute laterally to midrib; margins entire, meeting, of a pleasing grass-green colour above, and very scabrid (sub-muricate) with white scattered hairs; petioles pubescent, nearly 1 line long, and very striking from their white

colour with a yellowish tinge; stipules two or more, half the length of leaves, subulate, erect, grey. Flowers very numerous at tops of branches, in small axillary cymose-panicles of 6–8 flowers, twice the length of leaves; pedicels about 1 line long, each with two scarious brown bracteoles at base. Petals 0. Calyx large, spreading, rotate, white, petaloid, 2 lines diameter, pubescent on outside (with pedicels and peduncle), lobes broadly ovate, reflexed, with a central ridge the whole length above, margins incurved, apices sub-acute, thickened; stamens spreading and inclined, a little longer than the style, brown; anthers oblong, obtuse, light-brown; style very short, fuscous, 3- (sometimes 2-) branched; branches long, spreading, clavate; stigma large, globular, papillose, dark-brown, ovary half exserted, subconico-rotund, thickly villous with long, whitish, shining hairs; cocci 3, narrow elliptic, obtuse, concave.

Hab. Growing with *Leptospermum*, on dry, open, hilly grounds, back of Poverty Bay; 1885: *Mr. H. Hill.*

Obs. A species certainly very new to the common northern New Zealand species (*P. phylicifolia*, Lodd.), but differing from it in several characters, the most striking being its bright-green foliage, (which colour it also retains in drying,) and its longer panicles of much larger flowers, that are spreading, very white, and conspicuous; an entirely different looking plant from its northern congener.

Order XXVII. HALORAGEÆ.

Genus 1. **Haloragis**, Forst.

1. *H. minima*, sp. nov.

Plant very small, glabrous, wiry, prostrate and creeping, rooting at nodes; root-stock and rootlets glabrous; branches ascending, 1–2 inches high, few (4–6) leaved. Leaves opposite, sub-orbicular and orbicular-ovate, not cordate, apiculate, about 1 line long (sometimes, but rarely, 1½ lines), crenate or inciso-serrate with minute coloured teeth 2–6 to a leaf, thickish, nerveless, light-green. Flowers very minute, scarcely ½ a line long, simple-panicled and racemed at ends of branches, opposite in pairs, lowest pair very distant from the rest on peduncle, upper ones crowded, pendulous on short pedicels, axillary, springing from simple entire foliaceous green bracts or floral leaves, with very minute coloured bracteoles at base of pedicels; calyx-tube sub-globular or turbinate, 8-ribbed, glabrous, shining, dark-red; lobes large, deltoid, green with purple margins; petals boat-shaped, conniving, apiculate, dark-purple-red, anthers exserted, oblong, obtuse base and tip; stigmas very plumose; fruit not seen.

Hab. Tarawera, high lands between Napier and Taupo; December, 1884: *Mr. H. Hill.*

Obs. A species pretty closely allied to its small New Zealand congeners, *H. depressa*, Hook. fil., and *H. micrantha*, Brown; and also to some of the smaller Australian and Tasmanian forms, but is abundantly distinct in many particulars.

Genus 3. **Gunnera**, Linn.

1. *G. flavida*, sp. nov.

Plant glabrous, erect, 3–4 inches high; leaves 7–9, radical, membranous, broadly elliptic, $\frac{3}{4}$–1 inch long, margins sinuate-crenulate, petioles 1–2 inches long. Scape erect, very stout, much longer than leaves (about 4 inches), springing from root-stock below leaves. Flowers not seen. Fruit in a spike (or sub-raceme) 2 inches long, drupes fleshy, $1\frac{1}{2}$–2 lines long, sub-turbinate, compressed, patent, light yellow, scattered and pedicelled below, sub-sessile and pretty close together above.

Hab. Swampy ground near Tahoraiti, County of Waipawa; April, 1885: *Mr. H. Hill.*

Obs. A species having some affinity with *G. prorepens*, Hook. fil., but differing in several characters, as size and form of leaves and petioles, length of scape, and position, shape, and colour of ripe fruit; which in *G. prorepens* are sessile, very compact, and bright-red. I have received, through the kindness and courtesy of Mr. Hill, several good and whole specimens, and they do not vary.

Order XXXIII. UMBELLIFERÆ.

Genus 1. **Hydrocotyle**, Linn.

1. *H. colorata*, sp. nov.

Plant hirsutely-pilose; stems stoutish, 1–2 feet long, creeping, rooting at nodes 1–2 inches apart, usually one leaf and one peduncle bearing flowers from each node. Leaves pale-green, often purple-margined, soft, rough above with muricated points and white sub-succulent strigillose hairs, 8-10 lines diameter, orbicular-reniform with a very broad sinus, 7-veined, 5-lobed (the two outer lobes being larger and sub-lobed), lobes cut $\frac{1}{3}$rd to middle, each acutely and many toothed; petioles very long, 3–5 inches; stipules rather large, membranous, shining, coloured pink, sharply laciniate. Flowers: peduncles $\frac{3}{4}$–1 inch; heads small, globular, many-flowered, 15–30; petals broadly-ovate, acute and concave, whitish-yellow streaked with red on the outside, pinkish within, very shortly pedicelled; bracteoles small, linear-spathulate, obtuse, appearing above flower-buds and covering them before expansion, and persistent. Fruit very small, $\frac{1}{16}$ inch diameter, glabrous, chestnut-brown; styles distant, much recurved; carpels somewhat turgid, with a narrow ridged rib on each face; back acutely ridged; dark-brown when fully ripe, persistent.

Hab. In low spots, margins of woods near Norsewood, County of Waipawa; 1884–85: *W.C.*

Obs. I. This plant forms large dense patches, overrunning all low herbage, roots, twigs, etc., in a very tangled way; it has, however, a pretty uniform and striking appearance from its pale colour and neat leaves. It grows profusely in three or four spots in the locality named, but I have not observed it anywhere else.

Obs II. This species has some affinity with *H. moschata*, Forst., also with *H. compacta*, A. Rich., (another New Zealand species,) and probably with some Australian and Tasmanian species (as *H. hirta*, Br.), judging from diagnoses of Hook. fil., and Bentham; but, in my opinion, is very distinct, and one not readily confounded with our many New Zealand species.

2. *H. alsophila*, sp. nov.

Plant weak, glabrous, prostrate, creeping, much entangled; stems 1–2 feet (or more) long, rooting at nodes. Leaves rather distant on stems, 1 inch or more apart, membranous, bright green, sub-orbicular-reniform, 9–14 lines diameter, 8-veined and lobed, the four central lobes large and rounded at tips almost entire, or each lobe having three blunt crenate-serratures, the two outer lobes crenate-toothed at base; sinus large; lamina reticulate; petioles 2½–3 inches long, nerved, with a few long flaccid succulent jointed white hairs immediately under the leaves, each one enclosed in a pellucid tubular membrane; stipules large, very membranous, largely and finely reticulated, margins entire. Peduncles very short, about 2 lines long, stoutish; umbels 9–11 flowered (usually 10); flowers small, pedicelled; pedicels short, stout; bracteoles bladdery, obtuse, concave; petals white; styles flexuous, incurved; stigmas stout, largely tubercled. Fruit small, $\frac{1}{20}$th inch diameter, glabrous, very thin, pale yellowish-brown; carpels with one rib on each face.

Hab. In dense dark forests, Seventy-mile Bush, County of Waipawa; 1882–85: *W.C.*

Obs. This plant grows profusely in large patches, extending many yards each way. It seems to be allied to *H. novæ-zealandiæ*, DC., and *H. heteromeria*, DC., but is quite distinct.

Order XXXVIII. RUBIACEÆ.

Genus 1. **Coprosma**, Forst.

1. *C. rufescens*, sp. nov.

A tall, slender, erect, distantly branched shrub, 9–12 feet high; bark greyish; epidermis slightly scaly. Branches and branchlets few, very long, slender, opposite, divaricate at nearly right angles, and spreading; branchlets densely hairy, with patent reddish hairs. Leaves few, somewhat scattered, mostly in distant pairs at tips of branches and branchlets, very membranous, sub-rugulose, broadly elliptic, sometimes (but rarely)

orbicular, 6–10 lines long, sub-cuspidate, slightly tapering at base, of a reddish-brown (sometimes of a dark-purple) hue above, pale dull-green below, closely reticulated; primary veins opposite, not extending to margin; margin finely crenulate and slightly recurved, largely ciliated with twisted variegated hairs; very hairy above and below on midrib and veins, with reddish hairs; petioles slender, 2 lines long, densely hairy; stipules hairy, broad, with long cuspidate subulate hard black tips. Flowers: *Male*, very small, under 1 line, hairy, shortly peduncled, 2–3 together; corolla membranous, shallow, cup-shaped, 4-lobed nearly to base; lobes large, spreading, ovate, 1-nerved, recurved; stamens exserted, pendulous; anthers large (for flower), elliptic, whitish: *Female*, single and axillary, but close together in opposite axils, sometimes three together; peduncle short; calyx minute hairy; corolla hairy, 1½ lines long, narrow infundibuliform, mouth 4-cleft, lobes recurved; stigmas 2 lines long, clothed with flattish obtuse scale-like pubescence. Fruit red, didymous, 3 lines broad, 1½ lines long, each half-drupe orbicular; often 2–3 drupæ very close together on opposite sides of the slender branchlets. Seeds globose, 1 line diameter, whitish, smooth, with a fine central ridge on the back, and a small and deep sub-orbicular concavity at their junction, giving them the curious appearance of little rounded univalve shells.

Hab. Scattered on margins of low forests, near Norsewood, County of Waipawa; 1874-85: *W.C.*

Obs. I. I have long known this species of *Coprosma*; but, as it was very rarely ever seen by me in fruit, and never in flower—from its flowering so very early in the spring, before that I should visit those wet and cold forests—and from my supposing it to be one of those already described, I paid no great attention to it. Last year, however, through going thither very early seeking *Hepaticæ* in fruit, I obtained flowering specimens, and this summer its fruit; and now, after patient and long examination, (for its flowers are very small and also scarce,) I have considered it to be a new and undescribed species; certainly, in some respects, pretty near to both *C. rotundifolia*, A. Cunn., and *C. tenuicaulis*, Hook. fil., but I think distinct from both, and from all other described species of this intricate and puzzling genus; its very peculiar seeds serve well to fix it. Some of its leaves are not unfrequently dark-coloured, of a peculiar purple-coppery, semi-bronzed appearance; and this hue sometimes extends to all on that branch or branchlet. The great scarcity of its ripe fruit I attribute to their being early eaten by birds and insects, as they are very fleshy and sweet.

II. I may also observe that the tips of its branches and branchlets often present a very singular appearance. A small, very hairy ball, ½ inch diameter, with a little crown of 3–4 narrow, long, and very hairy leaflets spreading from its summit,

is found there; a curious kind of gall-like excrescence, the work, doubtless, of some insect. A very similar one is also to be met with at the tips of the branchlets of *Hydrocotyle concinna*, Col., mentioned by me in my description of that plant. ("Trans. N.Z. Inst.," vol. xvii., p. 239.)

2. *C. heterophylla*, sp. nov.

Plant a small, slender, erect shrub 4–5 feet high, of irregular and diffuse growth; bark pale-greyish-brown. Branches long, loose, and very slender, thickly pubescent (as are also branchlets, stipules, and petioles,) with short white hairs; branchlets opposite, long, almost filiform, arcuate, few-leaved. Leaves few, scattered, usually in pairs about 1 inch apart, membranaceous, glabrous, light-green above, paler below, spreading, of various shapes and sizes—rhomboidal, sub-orbicular, lanceolate, and narrowly linear, 3–4 lines long, $\frac{1}{3}$ – 3 lines broad, tips acute, veins red and reticulated, margined; margins red and a little recurved, entire and slightly sinuate-crenulate, gradually narrowed into the petiole; petiole short, slender, under 1 line long; stipules very short but broad with a point, sub-ciliated. Drupe lateral, solitary on a short peduncle, generally on the under side of branches opposite to leaves on the upper, and at the outer angles of branchlets, globose, 2 lines diameter, purple-black, glossy, juicy, sweet; calycine lobes at base of drupe persistent, small, deltoid, pubescent, spreading. Nuts very small, elliptic, 1 line long, gibbous, very flat on their sides of junction.

Hab. In thick, dry woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species having affinity with *C. rhamnoides* and *C. divaricata*, A. Cunn., also with *C. concinna*, Col.,* but very distinct. It is a curious and striking plant in its foliage, from their extreme diversity; all the shapes mentioned above being often found on one branchlet. Its long, drooping branches are by far the most slender of all the species of the genus known to me; their being also so very bare of leaves helps to show their extreme tenuity. Flowers not seen; fruit plenty.

ORDER XXXIX. COMPOSITÆ.

Genus 1. Olearia, Mœnch.

1. *O. suborbiculata*, sp. nov.

Leaves sub-coriaceous, alternate, about $\frac{1}{2}$ inch apart, broadly elliptic, $1\frac{1}{2}$–$2\frac{1}{4}$ inches long, obtuse and sub-acute, base rounded and regular, margin entire in the lower half, slightly sinuate in the upper, with a few very small (scarcely developed) blunt teeth, glabrous, green and shining on the upper surface (but

* "Trans. N.Z. Inst.," vol. xvi., p. 330.

when young very pilose, and hairs there deciduous), greenish-white below, and thickly covered with short adpressed hairs, having longer ones scattered among them, veined, veins and midrib prominent below, finely reticulated above; midrib brown; petioles short, sub $\frac{1}{2}$ inch, stout, channelled, half-clasping, decurrent in a ridgy line to the next leaf below; a small orbicular leaf 4–5 lines diameter usually at base of branchlets; branchlets, petioles, midrib and young leaves densely clothed with silky adpressed brown-reddish hairs. Inflorescence sub-terminal and axillary in long loose slender corymbose-panicles, pale-coloured and hairy, 2–3 inches long, three together sub-fascicled or joined close at base with connate bracts at bases, each ultimate sub-panicle containing 3–4 heads on slender, nodding, and bracteolate pedicels, $\frac{1}{4}$ – $\frac{1}{2}$ inch long. Heads $\frac{1}{3}$ inch diameter, narrow, oblong, $\frac{1}{4}$ inch long; involucral scales laxly imbricate in sub 5 rows, outer scattered short brown and very villous, inner close, long, linear, pinkish-green, glabrous in the centres and densely shaggy-ciliate at margins, especially at tips. Flowers: of ray, 8–9, linear, oblong, tips mostly emarginate, white, spreading, sub-revolute; of disk, 6–7, yellowish, lobes broadly-ovate, obtuse, scabrid at tips on outside. Pappus white, rather short, irregular, outer shortest, not thickened at tips, scabrid. Achene small, cylindrical, sub-conical, obtuse, pilose. Receptacle pitted, borders large and ragged.

Hab. Hilly country in the interior, Patea, between Napier and Tongariro Mountain.

Obs. Of this plant I have only received one fair flowering specimen, from Mr. A. Lascelles (who, however, did not gather it himself); it is evidently a branch from a stout shrub, but some allowance must be made for the leaves, which may, lower down, be larger. Its alliance is with *O. nitida*, Hook. fil., and with *O. populifolia*, Colenso, belonging to that sub-section, (*apud* "Handbook N.Z. Flora,") though largely differing from both of those species.

Order LVII. LABIATÆ.

Genus 1. **Mentha**, Linn.

1. *M. consimilis*, sp. nov.

A small sub-erect and prostrate fragrant herb, branches 2–4 inches long, finely pubescent. Leaves few, distant, opposite, petioled, $1\frac{1}{2}$ – $2\frac{1}{2}$ lines long, sub-orbicular, and broadly ovate or trowel-shaped, very obtuse at apex and truncate at base, green, sometimes dark-pink below, margin (and veins) coloured pinkish-brown, slightly sinuate-crenulate, generally with one notch on each side near apex (sometimes two), and (together with bracts, calyx, and corolla) having many scattered pellucid

dots, and a few straggling white hairs on veins below. Flowers white, axillary, mostly in pairs, sometimes ternary and fasciculate, and occasionally single; peduncles short, stout, and (with pedicels) pubescent; pedicels slender, 2–2½ lines long, each with a pair of foliaceous ovate bracts on long petioles; calyx tubular-campanulate, 1½ lines long, villous and ciliate, with spreading white hairs, largely and strongly ribbed, about 15 ribs; ribs and margins of lobes coloured reddish-brown; lobes large, triangular, acuminate, villous on inside; corolla lobes large, flat, spreading, elliptic, very obtuse, slightly crenulate and waved, upper one bifid; stamens exserted, anthers lilac; style largely 2-lobed; stigmas much recurved.

Hab. Dry grassy spots, margins of woods near Norsewood, County of Waipawa; 1882–85: *W.C.*

Obs. I have known this little plant for some time, every summer observing it on visiting its habitat, and had supposed it to be identical with *M. cunninghamii*, Benth., yet not without doubts. However, on closely examining it this year (January, 1885), I have detected several characters (*vide descript. supra*) that are not in accordance with those of the N. species (*M. cunninghamii*), as severally described by Cunningham, Bentham, and Hook. fil. It is also much smaller in all its parts, except the flowers, which are larger.

Order LXVII. THYMELEÆ.

Genus 1. **Pimelea**, Banks and Sol.

1. *P. angulata*, sp. nov.

Branches stout, bark glabrous, brownish-red, studded with raised scars from fallen leaves. Leaves (and branchlets) glabrous, rather crowded, decussate, broadly lanceolate, sub-acuminate, about 1 inch long (a few shorter), 2–2½ lines broad, spreading and deflexed from base, flat but slightly concave towards tip, sub-coriaceous, green above, sub-glaucous and veined below, midrib not prominent, petiolate; petioles 1 line long, white, broad, and adpressed to stem; floral leaves 3–4, much like the cauline but narrower. Flowers terminal on short young branchlets 1–2 inches long, closely compacted in heads of 10–25 flowers, white, erect at first but spreading in opening, villous without, shortly peduncled, peduncles rather stout and very hairy; tube infundibuliform, ½ inch long, quadrangular and channelled, constricted below the middle and again swelling at the base, yellowish above and pink below constriction, hairs very long at base; lobes of perianth patent, 2–2½ lines long, broadly elliptic, sub-acute, sub-convex or raised longitudinally in the middle, with margins slightly incurved, tips resolute and ciliate; stamens largely exserted, divergent; anthers oblong, obtuse, dark orange; style length of tube, sometimes exserted, finely

corrugated at base; stigma sub-penicillate; ovary oblong, glabrous, hairy at tip around base of style; hairs long, white.

Hab. Open hilly country in the interior, at Patea, between Napier and Tongariro; kindly sent me by Mr. A. Lascelles.

Obs. I have had but one small branch of this plant, containing, however, 10 heads of flowers. It seems to be a short, much branched shrub, presenting a *Daphne*-like appearance, and would make a pretty garden plant; flowers inodorous. A few perianths possess 3, and even 4, fertile anthers, while many have 2 abortive filaments (some only 1) in addition to the anther-bearing ones, of the same length, and opposite to the other 2 lobes of the perianth. As a species it is very distinct from the known New Zealand ones, (and more so from those of Australia,) but it approaches *P. longifolia*, Banks and Sol., and *P. gnidia*, Forst.

Order LXXI. URTICEÆ.

Genus 4. **Australina**, Gaudichaud.

1. *A. hispidula*, sp. nov.

Plant small; every part, including flowers, being more or less hispid; stems 3–4 inches long, stoutish, implexed, finely and closely retrorse-pubescent, procumbent, creeping, rooting at nodes; branches numerous, short, ascending, $\frac{3}{4}$ – 1 inch long. Leaves small, sub-reniform and sub-orbicular, always broader than long, truncate at base, 1–2 lines long, $1\frac{1}{2}$ – $2\frac{1}{2}$ lines broad, largely and regularly 5-crenate, hispid and rough with raised points and short white hairs, dark green above, pale below, veins very stout below, and with margins red; petioles rather long, slender, reddish; stipules 2 lines long, subulate, hairy, recurved. *Male* flower single, or 2–3 together, in upper axils on one long succulent peduncle, twice the length of petiole; perianth sessile, diverging, sub-boat-shaped, divided at middle into two concave lobes, the outer one the largest, membranaceous, bladdery, light-green splashed with red, margins irregularly crenulate, dark-green; stamen large, stout, glabrous, transversely ribbed on the back, much recurved; anther large, petaloid, pure white splashed with red on the outside. *Female* flower in lower axils, in pairs but separate, sub-sessile with two small coloured bracteoles; perianth ovate, sub-compressed, semi-transparent, light-green with a narrow dark-red margin, mouth somewhat 3-fid, tips laciniate; style and stigma excluded, as long as perianth, obtuse, recurved, brown, very shaggy, hairs flat and branched.

Hab. Sides of streams in shaded spots near Norsewood, County of Waipawa; 1883–85: *W.C.* Also eastern bases of Ruahine mountain range, same county; November, 1885: *Mr. A. Hamilton.*

Obs. A species very nearly allied to *A. pusilla*, Gaud. (which also grows plentifully in or near the same localities), but is very much smaller, and differs from that species in several particulars (*vide descript.*). I have occasionally found two perfect stamens issuing from one male perianth; and in a very few specimens, the female perianth in the upper axils above the male; and, in one instance, both male and female singly in one upper axil.

Class II. MONOCOTYLEDONS.

ORDER I. ORCHIDEÆ.

Genus 1. **Earina**, Lindley.

1. *E. alba*, sp. nov.

Stems stout, 8–10 inches long, sometimes branched at or near base. Leaves alternate, sessile, sub-linear-acuminate, acute, broadest near base, thickish, rather harsh and sub-rigid; petioles long, clasping, decurrent, extending to within the petiole below, black margined. Flowers terminal in compound panicles, 2–4 inches long, rather close-set, sub-distichous, each sub-panicle usually containing three flowers; bracts numerous, imbricated, striate, brown, the lower acuminate and fimbriate, the upper obtuse with a small mucro. Perianth pure white, 5–6 lines diameter, segments of equal length, spreading, recurved, obscurely 3-nerved, very obtuse; sepals ovate-oblong, margins entire; petals broadly obovate, crenulately notched on the middle of the upper margin; tip broadly oblong (or sub-5-sided), entire, obtuse or slightly retuse at apex, margins corrugated and incurved, two small ochraceous-yellow spots near the centre of tip, and two small greenish crescent-shaped calli beyond those spots and near the base. Column sub-hooded, tip ochraceous-yellow (exactly same hue as the two spots); appendages overhanging in front below anther, and produced in 4 small obtuse teeth and a minute tubercular wing on each side, with 2 minute mammillary-like dots in front, immediately below stigma. Ovary long, cylindrical, striate, twisted.

Hab. On edges of rocky cliffs and on dry stony declivities, and about the dry exposed roots of *Fagus solandri*; banks of River Mangatawhainui, Seventy-mile Bush, County of Waipawa; 1878–85: *W.C.*

Obs. This plant in appearance closely resembles *E. autumnalis*, Hook. fil., of which it may (by some botanists) be considered as a variety. It possesses, however, sundry characters which that species has not, or which, at all events, are not given in any published description of it that I have seen. Indeed, Hook. fil., says of the genus, "disk eglandular;" whereas the disk of this species possesses two crescent-shaped greenish calli. *E. autumnalis*, which is so very common in the woods at the N., is a larger and fresher-looking plant, with flowers "speckled and sweet-scented," and is always epiphytical. Can difference

of situation bring about change in characters as well as in habit? This plant is very plentiful in the locality named, causing those dry woods and stony cliffs to look lovely in the autumn season. It has given me a deal of repeated trouble and research, extending over several years, as for a long time I only took it to be a variety of *E. autumnalis*.

Genus 5. **Gastrodia**, Br.

1. *G. leucopetala*, sp. nov.

Root a long sub-cylindrical greyish-flesh-coloured pubescent tuber, encircled throughout with several rows or rings of scarious long light-brown ovate-acuminate scales, the rows being pretty regular and close together, of about 5 rows to 1 inch, somewhat resembling the sheaths on the stem of some species of *Equisetum*. Stem 2 ft.–2 ft. 9 in. high, erect, sub-succulent, stout, 8 lines diameter and cylindrical below, sub-angular at top, smooth, light-brown with short purplish stripes; 8–9 bracts, perfoliate, membranaceous, distant, on lower part of stem, margins entire, dark purplish-brown, spotted with light-coloured spots much like perianth. Flowers 20–40 at top of stem in a raceme 10–15 inches long, pendulous, rather distant, scattered, pedicelled; pedicels 2½ – 4 lines long, each with a single sessile bracteole at base 2–2½ lines long, 1 line broad, ovate-acuminate, sub-scarious, reflexed, coloured like those of lower stem but darker. Perianth thickish, papillose, dark brownish-green spotted with large light-(sub-fawn-) coloured spots without, whitish within, ventricose at base, anterior portion much curved upwards, 6–7 lines long excluding ovary, mouth open, 4½ lines diameter, quinquefid; segments spreading, veined, veins branching at tips, margins crenulate; two lateral sepals largest, deltoid, sub-acute and re-curved; upper sepal oblong, obtuse and emarginate; two lateral petals pure white, adnate, projecting from just within perianth tube, linear-oblong, concave, tips truncate and retuse, margins thickened, slightly crenulate, and recurved; labellum white, 3-nerved, disc contracted below the middle, the anterior portion sub-rhomboidal with two reddish longitudinal ridges, their margins thickly crenulato-fimbriate, rising divergent from the middle and united towards tip, but not joined to it; tip produced, thickened, recurved, verrucose and dark-brown at apex; anterior margins of disc finely crenulate-waved and incurved, the middle margins plain and spreading, posterior margins thickened, largely raised, waved and incurved; claw plain and grooved; ovary thick, ovoid, coloured as perianth, at first 3–4 lines long, after flowering twice that size.

Hab. In dark forests on the eastern slopes of the Ruahine mountain range, 1850–52; and in similar spots in the Seventy-mile Bush, between Norsewood and Danneverke, County of Waipawa, 1884–85: *W.C.*

Obs. I. I have long known this plant, (for upwards of thirty years,) but have never obtained good flowering specimens until this summer (January, 1885). I had, however, always suspected it to be a distinct species from the known endemic one (*G. Cunninghamii*, Hook. fil.), although the specimens I had detected in the woods in autumn travelling were always long past flowering. Having again met with it in those woods near Norsewood in April, 1884—but, as before, too late!—I marked those spots, and in visiting them again in January, 1885, (almost purposely,) I was rewarded with finding a *few* in flower on the top of two racemes, not, however, so many as I could wish, and in localities some miles apart. It now appears that the lowermost perianths on their long raceme expand first, and so regularly proceed up the stalk, like many other flowers produced in racemes and spikes. Having obtained, after all, only a very small number of really good flowers, (though plenty of both unopened and withered ones,) and being very desirous of sending them preserved in spirits to Kew, I have only dissected *one* perfect flower. Of this I have given a very minute description, in the hope of its being compared by some one of our working botanists with *G. cunninghamii*, which, I fear, is daily becoming more scarce.

Obs. II. I believe this plant to be very distinct from the other long-known New Zealand species, but, unfortunately, I have no specimens of that species left for comparison, and the description of it in our botanical books is neither complete nor minute. The pure white petals of this species are a most striking object when fresh and in its dark habitat; its lip, too, is widely different from that of *G. cunninghamii* (viz., the description of it given in our books of the New Zealand Flora); indeed, its lip is more like that of the Australian species, *G. sesamoides*, Br., though the perianth differs considerably. Of this species a fine drawing, with dissections and description, is given in the "Flora Tasmaniæ" (Bot. Antarctic Voyage, vol. vi.).

Genus 10. **Microtis**, Banks and Sol.

1. *M. papillosa*, sp. nov.

Plant rather stout, 1 foot–1 foot 6 inches high, finely and thickly papillose. Leaf erect, fistulous, ribbed internally, much longer than scape. Spike 1½–2 inches, flowers not crowded, sub 30; pedicelled; pedicel short, about 1 line long, stoutish; bracts oblong, acuminate, acute, 1-nerved, longer than pedicel, adpressed to flower. Perianth, upper sepal orbicular, 3-nerved, concave, apiculate; lower pair, ovate, acute, recurved; lateral petals linear-ovate, very obtuse; labellum oblong, waved and crisped, sub-fimbriate, bifid, sinus broad, truncate at base, apical lump at base of sinus, large, verrucose, continuous to the

two lumps at base of labellum, which are again divided, so making four.

Hab. Kaipara Heads, West Coast, North Island; *Mr. C. P. Winkelmann*; in letter, October, 1884. Flowering in October.

Genus 12. **Pterostylis,** Br.

1. *P. patens*, sp. nov.

Stem stout, 1-flowered, 4 inches high; 2–3 short ovate acute brownish and scarious bracts near base; 4–5 stem-leaves, equidistant, 3 inches long, 5–7 lines broad, sub-linear-lanceolate, not narrowed at base, sub-acute, recurved and revolute, thickish, finely papillose, keeled, 3-nerved, nerves obscure; uppermost leaf shorter, close to base of ovary, 1½ inches long, erect, half the length of perianth and sub-clasping. Perianth large, very open, bladdery, particularly at base, which is sub-globular, somewhat sub-quadrate in outline and very wide; upper parts of segments brownish-red, extending low down on lateral sepals. Galea erect, broadly arching and flat above, 2 inches long without tip; tip of dorsal sepal hooked, sub-acuminate, extending ½ inch beyond lateral petals, which are strongly 1-nerved, broad at tips, and acute; lower lip, the entire part thrown largely forward and downward, cuneate, ¾ inch long, much concave between lobes, their margins incurved above, and the lobes suddenly and completely reflexed below base of perianth, and extending downwards and horizontally beyond base of upper bract (or floral leaf), tapering into stoutish points more than 1 inch long. Labellum prominent, very irritable, linear-oblong, 10 lines long, 2½ lines wide, truncate at base, recurved at tip, with a longitudinal central stout ridge throughout; tip thick, obtuse, red, minutely papillose; claw stout, curved, nearly 2 lines long, a thick green protuberance on under surface opposite to its base, and a large tuft of stoutish spreading fimbriæ at tip, which are also lobulate or branched; column slender, wings incurved, large, more than 4 lines long, front margins sub-sinuate with a long finely subulate erect tooth from upper front angle rising above anther, lower lobes obovate or oblong and rounded, margins entire; stigma long, narrow, not prominent, at its central base an erect subulate white appendage, 2 lines long, projects forward from between two finely incurved corrugated lines or side-angles of lower column.

Hab. Forests, hilly country, near Norsewood, County of Waipawa; 1883–84: *W.C.* Glenross, County of Hawke's Bay; 1884: *Mr. D. P. Balfour.*

Obs. I. I first detected this plant in 1883, but then, while perfect, it was past flowering. Believing it to be a new species, I brought away carefully its tubers and planted them in a pot, and they have grown strongly and flowered. I have had, however, but one fresh flower to examine, but this was so large,

fully developed and gaping, that I had no difficulty in so doing, and that without breaking-up or even gathering the specimen.* Its form is striking, and its habit peculiar; all its floral parts being so very open and free, and its lateral sepals wholly deflexed horizontally; in these characters I have not seen anything like it among all the flowers of the genus, neither in these species of New Zealand, nor in those of Australia and Tasmania.

Obs. II. I may also remark that a slenderer plant of the same height grows close to the above, (in the pot,) as if from a twin-tuber, the three leaves of this are near the top of its stem, and are about as long as those of the other, but are sub-linear-spathulate; it has also a similar scarious bract at the base. It may be the barren or leafing form (young) of this species; as such obtains among some of the Australian and Tasmanian species—as, for instance, in *Pt. obtusa,* Br., Hook. fil., "Flora Tasmaniæ," pl. 115, C.

2. *P. rubella*, sp. nov.

Small, erect, slender, glabrous, 3–4 inches high. Leaves 2–3 at base, cordate, 3 lines long, petioles same length; cauline bracts 4, ovate-lanceolate, the lowest petiolate, the upper 3 sessile, half-clasping. Flower solitary, erect, 6–7 lines long; dorsal sepal arched, convex, striate, very acuminate, 9 lines long; lateral sepals (lower lip) connate, emarginate, with two long slender green tails, erect and spreading, 10 lines long, rising much above galea; petals, lanceolate-acuminate, acute, of same length as dorsal sepal; lip glabrous, dark-red, linear-lanceolate, acuminate, 4 lines long, under 1 line wide, grooved, tip thickened, obtuse; appendage curved, red, trifid-laciniate and minutely fimbriate or sub-penicillate, not villous; column, wings red, rounded above, not horned, largely produced and slightly fimbriate below.

Hab. Whangaroa, County of Mangonui; 1884: *Mr. R. W. Rowson.*

Obs. A species having some affinity with *P. trullifolia*, Hook. fil.

3. *P. tristis*, sp. nov.

Plant very small, rather dingy-looking, with a greyish-green appearance. Leaves small, 5–7 sub-rosulate, broadly ovate, obtuse or sub-acute, thickish, pale-green, deeply pitted, sub-concave, midrib stout, white and prominent below, margins closely and finely sub-crenulate, about ½ inch long, including petiole; petiole very broad and stout, 2–3 lines long, white, with three green veins. Scape stoutish, 2–2½ inches high, with

* I have, however, since writing the above, received flowers of several plants from Mr. Balfour, which fully agree with my description. (November, 1885.)

3–4 long acuminate bracts, clasping, adpressed, besides those under each pedicel. Flowers 2–3, on rather long pedicels, light-brownish striped with red, scarcely ¼ inch long, and nearly as broad, sub-second, slightly drooping, gaping; galea boat-shaped, much and somewhat abruptly arched with a short tip; petals broadly lanceolate or sub-rhomboidal, lower margin cilio-serrulate, tip acute; lower lip sub-orbicular, bifid nearly to middle, tips sub-acute, scarcely produced; labellum small, pale, highly irritable, broadly oblong, margin entire, very obtuse, with two minute crenulations at tip; appendage short, thickened and rounded at base, sub-erect, free, dark-green; column wings sub-quadrate, auricled, auricles very obtuse and rounded, their margins finely ciliate, not produced above, but front upper angle thickened and dark-green; the lower and slender portion of the column broadest in the middle; stigma small, scarcely prominent. Ovary (immature) long, clavate; valves widely separate, with narrow, raised, green margins and round apices.

Hab. Open turfy spots, flat lands, south bank of the river Waipawa; 1885: *Mr. H. Hill.*

Obs. I. This is an interesting little species, from its differing so very widely from all its known New Zealand congeners: yet, in several particulars, allied to some of the small Australian species, as *P. mutica*, Br., and *P. aphylla*, Lindl. Its little labellum is very irritable, (like those of some other species of this genus,) closing sharply up against the column with a spring on being only slightly breathed on! and so remaining. Their root-leaves, like those of the allied Australian species above-noted, mostly wither before flowering.

II. In the spring of this year (1885), I received from Mr. Hill two very small plants about ¼ inch high, with their tips of greyish leaves scarcely emerging above the tuft of mosses among which they grew, yet, fortunately, with their subterranean stems and little tubers complete. These I carefully planted, and was rewarded in seeing them flower in November. Mr. Hill informs me that it was on a spot where he was resting, during his journey, that he casually found them (in the mosses). I presume, from the smallness of the plant, and its dull, uninviting appearance, it has long been overlooked.

Genus 15. **Thelymitra**, Forst.

1. *T. alba*, sp. nov.

Rather stout, 8–9 inches high. Leaf linear, 10–11 inches long, 3–4 lines broad, rather thin, many-nerved (sub 10), nerves closely and finely papillose at back in lower part of leaf. Raceme 3 inches long, 8-flowered; pedicels ½ inch; bracts large, 1–1½ inches long, oblong, suddenly acuminate, very acute, 10-nerved (as also sepals and petals). Sepals light-greenish purple with very thin white margins; petals pure white; both with

labellum broadly ovate-acuminate with a mucro at apex, and all of equal size. Column rather short; tip recurved, deeply notched, sides of hood produced, with 2 angles, and notched in front between them; dark-brown with yellow margin; the appendages much produced in front, as high or higher than the column, very plumose; hairs white, branched, closely barred and knobbed at tips; side wings of column much excised; stigma large, sub-quadrate, sinuate and slightly laciniate at base; 2 small erect teeth in front, in centre of column margin; rostellum globular, prominent; anther tip long, subulate, obtuse.

Hab. Glenross, County of Hawke's Bay; 1885: Mr. *D. P. Balfour.*

Obs. A species having pretty close affinity with *T. longifolia*, Forst.; *T. nuda*, Brown; and *T. nemorosa*, Col.; but differing from them all in several characters.

Genus 17. **Prasophyllum**, Br.

1. *P. pauciflorum*, sp. nov.

Slender, erect; stem 7 inches high. Leaf-sheath 3 inches longer than spike, narrow, tip thickened, acute, blackish. Spike short, few-flowered (7); flowers distant, pedicelled, pedicels very short; bracts small, truncate with sinuous margin, or notched. Perianth rather small, sub ¼ inch, spreading, light yellowish-green; dorsal sepal broadly ovate, acute; lateral sepals united from middle downwards, acute slightly acuminate, entire not notched; petals linear, obtuse, 3-nerved, the lateral nerves only reaching half-way; lip small, broadly orbicular-ovate; lamina thin, 3-veined, the 2 outer veins branched, margin entire but slightly sinuate; claw very short; tip recurved with a small yellow globular lump adnate at the bend; column very short and thickish, with a broad membranous rounded hood at back above anther, margin of hood entire, and 4 minute erect linear lateral staminodia; ovary short, turgid.

Hab. Hills, country west of Napier; 1883: *W.C.*

Obs. I have obtained only one specimen of this plant; and, though early satisfied of its being very distinct from the three published New Zealand species, and also from all the Australian and Tasmanian ones described by Bentham in "Flora Australiensis," I wished to get more specimens before describing it, as there may be some variation in size and number of flowers; not, however, being successful, I now make it known.

Genus 18. **Orthoceras**, Brown.

1. *O. rubrum*, sp. nov.

Root, a small fusiform white tuber. Stem rigid, erect, slender, smooth, 1 foot high, greenish dashed with purple-red,

Leaves few; basal 2–3, green, erect, thickish, linear, very narrow, 5–6 inches long, less than 1 line wide, deeply channelled, margins conniving, very acuminate, tips piliferous; cauline 2, nearly equidistant, similar to basal but smaller, adpressed to stem, with large red-coloured membranaceous sheathing bracts at base, acuminate. Flowers 3–5, small, dark-red, thickish, rather distant, pedicelled in a short raceme at top of stem, the bract at base of pedicel broad, sheathing, membranaceous, ovate-acuminate, acute, 9–10 lines long, 3 lines broad, many nerved, not keeled. Dorsal sepal very broad, sub-quinquangulato-orbicular in outline, 5 lines long, 3½ lines broad, apex slightly obtusely-angled with a fine mucro, sub-10-nerved, margins thin, entire, incurved; lateral sepals very narrow, almost wiry, erect and curved, 8–9 lines long, deeply channelled, tips acute; petals thin, white, narrow-linear above, broad and spreading below, bifid at apex. Labellum heart-shaped, 4 lines long, 3 lines broad, slightly and finely transversely wrinkled, side margins incurved, tip acute; lateral lobes sub-ovate, obtuse, the middle lobe slightly larger, broadly-ovate-acuminate; the transverse callus at the base of the lateral lobes smooth, triangular, bifid at apex, and recurved towards column. Column, tip apiculate, sides conniving, the two lateral appendages finely subulate, rough.

Hab. Open grounds among fern, high clayey hills between Napier and Mohaka, Hawke's Bay; 1870–76: *W.C.* Glenross; 1885: *Mr. D. P. Balfour* (a single specimen only).

Obs. This plant has been long known to me; and, while I had my doubts as to its being identical with the northern form of this genus (*O. solandri*), mainly from the difference in colour, in its being more slender, and its general appearance, I never satisfied myself till this year; partly owing to my want of spcimens of the northern plant for comparison, as well as to my not possessing any full description of it, neither of the Australian species (*O. strictum*); for R. Brown, Lindley, A. Cunningham, and Sir J. D. Hooker, say very little about the two species. More recently, however, Bentham, in his "Flora Australiensis," has gone fully into the Australian plant; and as now I have also A. Richard's full description of the New Zealand one, with a folio plate of drawings and dissections, I have closely examined and compared this species, and I find it to be (as I had supposed) different, and that in several characters. Bentham, however, states that the two long known plants of Australia and New Zealand are but *one* species. His words are: "The New Zealand plant does not appear to me to differ in the slightest particular" (*loc. cit.*). This may be the case with the old and early described New Zealand one; which, from description, drawing, and dissections by A. Richard, is very distinct from this species.

Order VII. LILIACEÆ

Genus 6. **Arthropodium**, Br.

1. *A. reflexum*, sp. nov.

Plant small, leaves many, 10–12, nearly flat, grass-like, membranaceous, green, glabrous, margins purple, sub-linear-lanceolate, acuminate, tips acute, 9 inches long, 3 lines wide, spreading, drooping, obsoletely veined, keeled below, half-clasping and deeply canaliculate at base, with margins conniving, bases (also those of pedicels and scape) thickly purple-spotted; scape 9–10 (or more) inches long, erect, sub-flexuous, very slender, almost filiform, less than ½ line diameter at base; cauline or floral leaves large, foliaceous, spreading, cernuous, sub-linear, acuminate, broadest near base, sessile, half-clasping, lowest 4½ inches long, 2 lines wide, upper 1 inch long and 1 line wide. Flowers distant, lowest internode 1¾ inches, alternate, somewhat sub-verticillate, axillary, (two together in lowest leafy bract only, but separate,) with a small, coloured, broad, and truncate membranaceous bracteole between pedicel and scape; raceme 6 inches long, 9–11 flowered; pedicels ¾ inch long, slender, drooping, jointed above the middle, lowest longest; perianth white, wholly and strictly reflexed and nodding (like *Cyclamen*); segments 6, sub-convex, 2½–3 lines long, green at bases; three outer, oblong-ovate, obtuse and thickened at tips, 3-nerved; three inner oblong, rumpled, sub-fimbriate above, emarginate; filaments white, much shorter than perianth, 1¾–2 lines long, slender, naked, more than ⅓rd length from base, densely hairy above, but not close up to anther, hairs very short at top, being gradually reduced in size upwards, large and bushy at middle, patent, moniliform, largely clavate and compound-branched; anthers pale, small, about ⅓rd line long, oblong, broadest at base, but not divergent, recurved at tips; style glabrous, erect, much longer than anthers, 2 lines long; stigma spreading, finely penicillate; ovarium green, glabrous, sub-oblong-globose, flattened at tips. Capsule (ripe) bluntly deltoid, 2 lines diameter, depressed, very membranous, green, much rugose from seeds; seeds many (15), broadly-oblong, turgid, slightly and irregularly sub-compressed, black, shining, very minutely dotted; funicle long, slender, adhering.

Hab. Shaded sides of mountain streams, Seventy-mile Bush, County of Waipawa; 1870–83: *W.C.*

Obs. I. This graceful little species is nearly allied to our other small New Zealand species, *A. candidum*, Raoul, and also to *A. neo-caledonicum*, Baker,* differing, however, in several characters. I have long known this plant, and always suspected

* See "Journal Linnean Society," vol. xv., p. 352.

it to be distinct from *A. candidum;* but not till this summer (January, 1885) did I obtain it in its flowering state, and then only by bringing its roots away last year from the woods and planting them in a flowering pot: they have grown well and rapidly.

Obs. II. This plant has some peculiar habits, which, having repeatedly noticed them, are worth recording. It only opens one flower at a time, beginning at the lowest, when the segments of its perianth quickly assume their tightly reflexed position, and its anthers are already bursting at their tips; it only remains open for one day, closing at nightfall, when the segments, etc., are closely and longitudinally appressed to the ovary, where they remain. The ovary rapidly swells, and its pedicel elongates. After the first lowest flower has flowered, the second one in the same axil (scarcely visible before) begins to lengthen its pedicel, but this did not expand. Its leaves begin early to wither at their tips, before the plant has opened one-third of its flowers.

Order IX. JUNCEÆ.

Genus 8. **Luzula**, De Candolle.

1. *L. sub-clavata*, sp. nov.

A tufted erect herb, branching from the roots. Culms slender, sparingly leafy, 18–24 inches high. Leaves numerous, flat, and grass-like, 5–6 inches long, 2 lines wide, 16-nerved, with distant transverse nettings, apices thickened terete and sub-clavate, margins slightly and distantly serrulate, and sparsely ciliate with very long whitish hairs. Flowers in a long, loose, slender panicle of 2 (sometimes 3) sub-sessile broadly ovoid many-flowered heads, several inches apart; heads ½ inch diameter, simple or compound, on short pedicels, the lowermost head having 2–3 long narrow foliaceous bracts at base, their apices thickened and terete like those of the leaves, the uppermost head is usually bractless. Perianth small, 1 line long; segments ovate-acuminate, whitish-brown with a dark central line, much longer than capsule; stigmas long, flexuous, and rough. Capsule sub-ovoid, triquetrous, smooth, shining; valves broadly oblong-lanceolate, apiculate, with a strong central vein. Seeds oblong, turgid, darkish brown, shining, finely reticulate-striate, with a dark spot at tip, the hilum produced and puberulous, and a narrow white line forming the ventral suture. Bracteoles small, broadly ovate, white, shining, adpressed; tips minutely ragged with a mucro.

Hab. Dry woods, banks of River Mangatawhaiiti, between Norsewood and Danneverke, County of Waipawa; 1885: *W.C.*

Order XI. CYPERACEÆ.

Genus 4. **Scirpus**, Linn.

1. *S. novæ-zealandiæ*, sp. nov.

Rhizome creeping, branched, woody; stems simple, and branched at base. Culm slender, 2 feet high, 1 line wide, trigonous, cylindrical at base, solid, smooth, pale sea-green. Leaves 3–4, much shorter, longest about half the length of culm, distant, linear, sub-grass-like, 1½ lines wide, smooth and same colour as culm, deeply channelled, sheathing, apices blunt, margins of tips scaberulous; sheaths long; ligula large, elliptic, membranous; sheathing bracts at base 3–5, broad, 3 lines wide, transversely netted, uppermost abruptly contracted at apex and cuspidate; cusp narrow linear, nearly 1 inch long. Spikelet solitary, lateral, broadly ovoid, 3–4 lines long, 1½ lines broad, sessile, dark red-brown, 12–15-flowered. Glumes broadly ovate, very concave, densely imbricate, membranaceous, very thin at margins, erose and sub-fimbriate towards apex, bifid, aristate, much keeled, red, glabrous, shining; outermost obsoletely 3-nerved, very broad and clasping, transversely wrinkled, finely fimbriate, largely and coarsely aristate. Involucral bract 1½ – 2¼ inches long, erect, continuing the culm and precisely like it, slightly hollowed into a sheath at the base, with short broken and scarious margins; tip flattened, sub-acute, margins scaberulous like leaves. Style long, blackish-brown; stigmatic branches 3, longer than style, flattened at bases, roughish, obtuse. Anthers linear-acuminate, with a long acuminate connective, truncate at base, light-yellow; filaments flat, 1-nerved, pale-coloured. Hypogynous bristles 3–4, shorter than nut, linear, obtuse, largely retrorse-scabrid, red-brown. Nut broadly obovoid, $\frac{1}{10}$th of an inch long, tipped with a small black point remains of style, gibbous, flat on one side, smooth, shining, pale drab-brown minutely spotted with red; clustered and sessile in little niches around short thick sub-tetragonal spike, upper 3-4, small, abortive.

Hab. Sandy flats, low margins of rivers, Hawke's Bay; *W.C.* Near Puketapu; 1885: *Mr. D. P. Balfour.*

Obs. A species having affinity with another indigenous species, *S. triqueter* (of R. Brown), and of "Flora Novæ Zelandiæ," and also of the "Handbook New Zealand Flora," but said by Bentham not to be the *S. triqueter* of Linn., but to be *S. pungens*, Vahl, ("Flora Australiensis,") differing, however, in several characters.

Genus 6. **Isolepis**, Brown.

1. *I. reticularis*, sp. nov.

Plant small, gregarious, loosely tufted, filiform, flaccid, sub-erect and drooping, light-green. Culms 5–8 inches long, sub-cylindrical, compressed, channelled on inner surface. Leaves

many, shorter than culm, each one (also culm) issuing from a fistular sheath; sheaths $\frac{1}{2}$ – 1 inch long, red, sulcated, glossy, truncated with a rather long, abrupt linear mucro. Involucral bract usually 1, erect, obtuse, continuation of culm, $\frac{1}{4}$ – $\frac{1}{2}$ inch long. Spikelets ovoid-acuminate, generally 3, lateral, 1–2 lines long, the middle one longest, pale coloured with conspicuous green stripes, sometimes only 1, and also (but rarely) 4–7 and then proliferous, with small leafy bracts arising from coloured sheaths. Glumes numerous, about 15, concave, broadly ovate, sub-acute, whitish, sprinkled with oblong red dots, and a broad green line on the back, but not keeled, strongly and many-nerved, netted with numerous transverse veinlets, margins entire, thin. Nut very small, elliptic, slightly sub-trigonous with a narrow produced margin and a long apiculate beak, shortly pedicellate, pale whitish-brown, smooth, glossy. Style red-brown; stigmatic branches 3, long, curved, scarcely scaberulous but roughish, as with minute tubercles. Stamen 1, filament clavate, often persistent on nut and nearly twice its length.

Hab. Low wet grounds, sides of rivers, and damp shaded woods, where it forms large grass-like beds; Seventy-mile Bush, County of Waipawa; 1880–85: *W.C.*

Obs. A species having pretty close affinity with *I. inundata*, *I. riparia*, and *I. prolifera*, Brown, (*Scirpus* of Sprengel, and of Bentham, "Fl. Australiensis,") but approaching nearest to the former; differing, however, in its many leaves, and in its nut being narrower and obtusely angled, with a long terminal point; and from them all in its peculiar netted scales, and in its coloured truncated sheaths to leaves and culm.

Genus 10. **Gahnia**, Forst.

1. *G. scaberula*, sp. nov.

Plant bushy, in moderate size tufts, leaves rough, 3–4 feet long, spreading; culms terete, smooth, leafy, about same length as leaves. Panicle 18 inches long, compound, slender, nodding, general colour light-brown; sub-panicles and pedicels light yellowish-green; peduncles and sub-peduncles slender, roughish, compressed; pedicels scabrid, flattish, rigid, 2–4 lines long; floral bract scaberulous, 7-nerved, very acuminate, sub-awned, dark red-brown, edges scarious and pale-coloured. Spikelets small, slender, 3 lines long, with generally seven glumes closely appressed; the three outer glumes minutely rough above, dark red-brown, the outermost one 3-nerved, scabrid on central nerve, aristate, barbed; the inner glumes 1-nerved, acuminate, very small and convolute, with very concave margins and obtuse apiculate tips, smooth below, scabrid at tips, the innermost one wholly puberulent and emarginate, their bases white, tips reddish-purple. Stamens: anthers 4, linear-lanceolate, $1\frac{1}{2}$ lines long, pale straw-colour, with a long acuminate and serrulate

connective, rather abrupt at base; filaments a little shorter than anthers. Style long, scabrid, especially at base, 2-branched, each branch with two very long flexuous stigmata, sometimes with an odd one, five in all. Nut transversely grooved within, sub-spindle shape, 3 lines long, obtusely ribbed, shining, red, apex black and scaberulous, slightly produced and crowned with the persistent base of style, when fully mature pendulous in long hypogynous scales (or "filaments" of authors), which are 4–8, bright-red, long and very narrow, much crumpled and twisted.

Hab. Dry spots, margins of forests, Seventy-mile Bush, County of Waipawa; 1880-85: *W.C.*

Obs. I have known this plant for several years, but it was only during this summer (1885,) that I obtained perfect and complete specimens; this, however, was partly owing to my not greatly caring to gather it for examination, believing it, from its general appearance, to be one of the already-described species.

[See my note on this genus at the end of my descriptions of these *sp. nov.*]

2. *G. parviflora*, sp. nov.

Plant forming small diffuse bushy tufts. Leaves very narrow, almost linear, 3 lines wide, 3 ft. 6 in. long, with long filiform tips, margins thickened and recurved, upper part of leaf scabrid, the lower smooth. Culms 2 ft. 6 in. to 2 ft. 9 in. long, very leafy, cylindrical, smooth; panicle 18–20 inches, slender, open; sub-panicles (6–7) 3–4 inches apart; spikelets distant, not crowded. Floral bract broadly ovate, corrugated, aristate, arista short; sub-panicle, stem sub-4-angled below, angles rough, 3-angled above, compressed, scabrid. Spikelet broadly obovate, sub 3 lines long, blackish; glumes all large and broad and nearly of equal size, oblong-ovate, acute, not acuminate, loosely concave, smooth, pubescent or roughish at tips, the outer glumes largely corrugated, the outermost much shorter than spikelet. Style long, black, thick at base, with short red hairs; stigmas 4, sub-fasciculate, long and branching from below close to the forking of the style. Nut narrow ovoid, somewhat turgid, 2½ lines long, slightly grooved, whitish, tip brownish, red and shining when mature and old, transversely rugulose within, base of style persistent. ? Hypogynous scales ("filaments" of authors), 8, very long and fine, much crumpled and entangled, dark-red.

Hab. Scattered among low bushes and small scrubs, dry hills, near the bridge over the River Whakaruatapu, Seventy-mile Bush, County of Waipawa; 1881: *W.C.*

3. *G. exigua*, sp. nov.

Plant rather small, slender, spreading, forming small separate tufts. Leaves narrow, about 2 feet 6 inches long, striate

below, scabrid, margined, excessively long filiform at tips. Culms 3 feet long, slender, leafy; stem-leaves very long, drooping, narrow and filiform at tips. Panicle very slender, 2 feet to 2 feet 6 inches long; sub-panicles distant. Floral bract narrow, excessively acuminate, 13–14 lines long, (of which the filiform beak is more than half,) slightly roughish, light-brown. Spikelet very slender, 2½ lines long, narrow, obovate-lanceolate, with sharp tips of outer glumes extending beyond, dark-brown; pedicels filiform, scabrid, rigid, 2–4 lines long; 4 outer glumes very acuminate and decreasing gradually in size, 1-nerved, minutely scabrid on nerve at back and on margins (especially the two outer), red-brown; 3 inner small, obtuse, apiculate, smooth, white below, reddish and finely scaberulous at tips. Stamens: anthers 4, subulate; connective long, acuminate, acute, entire, minutely and distantly roughish under a lens, base sub-sagittate; filaments shorter than anthers. ? Hypogynous scales ("filaments" of authors) 6–8, very long, fine, crumpled and twisted, reddish-brown, filiform below, broader, flat, 1-nerved, and obtuse at tips. Style rather long, slightly rough, thicker and pubescent at base, pale red-brown. Stigmas 3 (rarely 4), long, sub-fasciculate, roughish, dark-brown. Nut (immature) minutely puberulous at tip; ripe, 2½ lines long, broadly lanceolate, shining, grooved, and obtusely angled, red with a black spot at tip, base of style persistent, transversely grooved within.

Hab. Among shrubs, etc., on dry spurs of hills near Matamau, County of Waipawa; 1882: *W.C.*

4. *G. multiglumis*, sp. nov.

Plant forming medium size tufts; leaves and culms of equal length, about 5 feet long, spreading, drooping. Leaves pale-green, narrow, almost linear, 4 lines wide at broadest, upper portion and tips excessively narrow, almost filiform, margined, slightly scaberulous below, more so above; culms leafy, straw-coloured. Panicle 3 feet long, slender, graceful, secund, compound, with about twelve compound (3-branched) drooping sub-panicles, the lower ones being 3–4 inches apart; floral bract dark-brown, appressed, enclosing 2 spikelets, small, very acuminate, arista extending length of spikelet; peduncle and pedicels flat, narrow, rigid, slightly scaberulous at edges, straw-coloured; pedicel length of spikelet; spikelet dark reddish-brown, broadly obovate, turgid, sub 3 lines long, possessing 9 scales, all shorter than spikelet or (immature) nut, 1-nerved, minutely and closely pubescent at tips; the 3 outer very small, half the length of spikelet, narrow, ovate, acuminate, tips sharp, diverging; the 3 next broadly ovate, acute, transversely wrinkled; the 7th scale is the largest, broadly oblong, apiculate, much concave and overlapping at base; the 8th oblong; the 9th (and terminal) narrow-

oblong or sub-lanceolate, and rather large for the innermost scale, and (with the 8th) apiculate and concave. Nut narrow, spindle-shaped, sub 4-sided at the middle, much grooved, 3 lines long, white, shining, black tipped, with base of style persistent, transversely ribbed within, ribs few, 6–7; style long, 2-branched, stigmatic branches 4, sometimes 5, blackish rough. ? Hypogynous scales ("filaments of anthors") 8, very long and fine, and excessively crinkled and compacted, both within spikelet around base of nut as well as outside, light red-brown.

Hab. Dry *Fagus* forests near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species having pretty close natural affinity with the preceding species, *G. parviflora.*

A Note on the Genus **Gahnia.**

It is a curious fact that no modern botanical author has given any description of the anthers of *Gahnia*; indeed, they are not once mentioned or alluded to by them, not even when describing the genus or its species. Not by Brown, "Prod. Fl. Nov. Holl.;" nor by Kunth, usually so very complete, "Plant. Enum.;" nor by Hooker, in both "Fl. Nov. Zel.," and in the "Handbook Fl. N.Z.," and also "Fl. Tasm.;" nor by Bentham, in "Fl. Austral." Forster, however, who constituted the genus, does so, giving at the same time a characteristic drawing of the anthers of his type species ("Char. Gen. Plant.," tab. 26); at the same time Forster omits altogether the long "filaments." La Billardiere, who described two species, and has given plates of them with dissections in his large work, "Prod. N. H. Plant.," shows the anther; and in both Forster and La Billardiere there is also the peculiar and specifically distinct connective. In two of these species now described by me I have been able to give their respective anthers, in which their connectives also differ considerably, and thus afford a valuable specific character. Both Forster and La Billardiere, who describe the anthers and stamens of their species, show how very short the stamens are; which, however, by the latter are said to lengthen after flowering, but only (as shown in his plates) in a very limited degree. Subsequent botanical authors have said that this lengthening of the stamens forms those greatly elongated and crumpled "filaments" so highly characteristic of this genus. I have, however, my doubts as to whether those are not hypogynous scales (some of them at least), similar, only much longer and flaccid, to those of the closely allied genus *Lepidosperma.* At all events, such is really the case in two of the four species I have described in this paper, (*G. scaberula* and *G. exigua,*) in which are to be found, at the same time, both short stamens bearing anthers and those long crumpled "filaments"—which

are also "broad, flat, 1-nerved, and obtuse at tips." Moreover, the "stamens" or "filaments" are almost invariably represented as being three or four in number—sometimes, but rarely, six; I find them, however, to be usually double that number, viz., eight. I had both hoped and intended to have paid some close attention to this subject during this summer (1885–86), in their native woods, and in their proper season of first flowering, (which was also the reason of my not having more closely examined in that particular those species I have herein described,) but the great distance from me of their known habitats (nearly one hundred miles), and my time now being fully occupied with other matters, prevent my doing so. I would, therefore, recommend this study to those botanists in New Zealand who may have both time and opportunity of performing it; and that not merely for determining whether those elongated filaments (or some of them) are really hypogynous scales, but for the purpose of ascertaining the several forms of the connectives of the respective species.

Class III. Cryptogamia.*

Order IV. MUSCI.

Genus 46. **Polytrichum**, Linn.

1. *P. ruahinicum*, sp. nov.

Stems simple, erect, rather stout, sub-rigid, red, 1–2 inches high, about ½ inch of lower portion bare. Leaves numerous, spreading; lower slightly decurved, upper erect; linear-subulate, 5 lines long, smooth, softish, green, opaque, margin finely pellucid and sharply serrate to base; tips acute, brown; nerve stout; base much and suddenly dilated; basal cells minute, sub-orbicular, and double-walled, those of the dilated membranous portion larger, linear-oblong and rectangular, and single-walled. Fruit-stalk single, lateral, stout, 4½ – 5 inches long, stiff, red, glossy, very flexuous or tortuous (as many as sixteen large crinkles in a single seta). Capsule oblong, 3-sided, gibbous above, 2½ lines long, sub-erect, green, constricted below mouth, margin of mouth bright-red; operculum large, conical, very obtuse, pale; calyptra very small, reddish-brown, naked, base narrow and much lacerated, very slightly hairy near base and at extreme tip, but only perceptible under a good lens.

Hab. On sides of gulleys, eastern slopes of the Ruahine mountain range, County of Waipawa; November, 1885: *Mr. H. Hill.*

* The paper I had prepared containing Cryptogamic plants (*sp. nov.*), was read at the ordinary meeting of the Hawke's Bay Philosophical Institute held in September, 1885: however, these in this paper (with a few others) were since discovered, and being six notable novelties, I embrace this opportunity of early making them known.—W.C.

Obs. This is a very striking species of *Polytrichum*, from the extreme length of its tortuous, thick, and richly coloured seta; its leaves, too, are much more of a pleasing green colour than is usual in this genus; while its capsule and calyptra also differ from those of its New Zealand congeners. Its nearest ally among our known southern *Polytrichæ*, is *P. magellanicum*, Hedw., from which species, however, it differs considerably. It might possibly fall under *Polytrichadelphus*, C. Muell. (*Cyphoma*, Hook. fil. and Wilson). I have received several fruiting specimens of this plant from Mr. Hill, in various stages of advancement, yet all possessing the same peculiarly-formed seta.

Genus 71. **Hookeria**, Smith.

§ Pterygophyllum.

1. *H. macroneura*, sp. nov.

Plant 3–4 inches high, of very close growth, erect, creeping below, much branched, especially at top; stems thick, dark, somewhat woody, densely matted with dark-brown hairs and rootlets; branches flat, forked, spreading, decurved, $\frac{3}{4}$–$1\frac{1}{2}$ inches long, 5–7 lines wide; stalks thickish above and very hairy to tips; hairs patent, pellucid, white, jointed. Leaves pale-dusky-green, quadrifarious (or somewhat sexfariously disposed), imbricated, large, thin, very obtuse, not margined, the upper half finely serrate, the lower entire; lateral spreading, orbicular-ovate or broadly elliptic, 2 lines long, dimidiate; dorsal and ventral orbicular, 2 lines diameter; nerve very stout, extending throughout $\frac{3}{4}$ths of leaf, forked near tip, and sometimes shortly 3-branched there; cells large, oblong-orbicular, much longer at the basal portion, and very much smaller at the margins, strikingly possessing a minute triangular cellule in every angular junction. Perichætial small, sub-linear-ovate-oblong, rather suddenly acuminate, margin entire, tips truncate with 2–3 teeth, and also 2–3 small teeth near apex; cells linear-oblong, mostly 4-sided. Fruit-stalk 12–14 lines long, erect, flexuous; wiry, twisted, glabrous, dark-brown, thickened at top, very slightly muricated or roughish towards top beneath, thickened at base. Capsule oblong, $1\frac{1}{2}$ lines long, dark red-brown, horizontal (much drooping when dry), largely tubercled at base, base thickened but not strumous; teeth, external, dark-brown, very acuminate, incurved, with two prominent dark distant dorsal ridges, and closely transversely barred throughout with denticulate margins, giving their long filiform tips a knotted appearance; internal, pale, acuminate, distantly barred, without intervening ciliæ.

Hab. On the ground, and on rotten sticks, edges of mud swamp; low dark woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A very fine species, having some affinity with *H. quadrifaria*, Smith; also *H. luteo-virens*, and *H. petrophila*, Col.,

but very distinct. Leaves remarkably crisp and contracted when dry, but quickly resuming their natural appearance on being wetted.

2. *H. maculata*, sp. nov.

Plant small, $\frac{3}{4}$ – $1\frac{1}{4}$ inches high, erect, cæspitose, closely imbricate, much and sub-palmately branched; branches flat, broadest at top, decurved at tips; densely matted below with brown rootlets. Leaves sexfariously disposed, closely imbricate, broadly elliptic, $1\frac{1}{2}$ lines long, all nearly alike, spreading; young leaves pale green, when old spotted at tips of a bronze colour, or each tip bearing a round spot of that colour; margins entire, but under a high power delicately and regularly denticulate; nerve red, very stout at base, extending about $\frac{4}{5}$ths of leaf, slightly forked near tip; cells sub-orbicular, excessively small except at the centre from middle downwards; there large, open, increasing in size to base, the basal cells sub-quadrately-oblong. Fruit-stalk very short, $1\frac{1}{2}$ – 2 lines long, black, twisted, flexuous, glossy, thickened at base; few. Capsule minute, about $\frac{1}{2}$ line long, obovate-oblong, sub-erect (horizontal when dry), finely reticulate, sub-tuberculate, sub-apophysate, blackish-brown, glossy, thickened at base. Operculum and calyptra not seen.

Hab. Shaded spots, base eastern slopes of Ruahine mountain range, County of Waipawa; 1885: *Mr. H. Hill.*

Obs. An interesting little species; its regularly spotted appearance giving it a peculiar aspect. It differs much from the other New Zealand species of this genus, its nearest ally being *H. sciadophila*, Col. I have received a large tuft of it from Mr. Hill, containing many plants, but as there were only three fruiting specimens, I did not break up one of them to ascertain the structure of the peristome and perichætial leaves. When the old leaves below decay, or are gnawed by some insect, the red nerves are left, presenting another peculiar appearance.

Order V. HEPATICÆ.

Genus 7. **Gottschea**, Nees.

1. *G. dichotoma*, sp. nov.

Plant large, procumbent and sub-pendulous, dichotomous, 8–9 inches long, much branched; branches repeatedly forked, spreading largely, leafy, 1–5 inches long, $\frac{1}{2}$ inch wide, light-green, flaccid; stems stout, cylindrical, woody, blackish, naked and rigid below. Leaves somewhat distant, free, imbricated, oblong-ovate, finely serrulate; ventral (or under) obtuse, very thin, flat, not plaited, ciliate on upper basal margin; dorsal (or upper) wavy, rumpled, margins slightly irregular, upper basal portion very broad, round, and overlapping, apex very acute, free; in their axils 2–3 small, narrow scale-like leaves, much ciliated. Stipules large, nearly 2 lines wide, situate within (or

above) the junction of leaves with stem, sub-orbicular-ovate, deeply emarginate, the upper half slightly and irregularly cilio-serrate, the lower entire; stipules on branchlets sparingly ciliate; ciliæ jointed. Cellules very small, distinct, compact, of irregular sizes and shapes, mostly rounded, sometimes sub-rectangular, extending also into the teeth.

Hab. On a rotten stump, forming a large handsome hemi-spherical clump, completely hiding its support, and with nothing else growing mixed with it, in a forest swamp among fern trees (*Dicksonia squarrosa*), near Norsewood, County of Waipawa, and only seen in that one spot; October, 1885: *W.C.*

Obs. This is a remarkably fine species, perhaps our largest; it has close affinity with *G. nobilis*, Nees, and might easily be taken for it at first sight. It differs, however, in its much larger size, in its procumbent sub-pendulous habit, and in being repeatedly forked; also, in the different shape of its leaves (both lobes, the upper lobe being also waved and rumpled), in their being more distant and open, and much less and more finely serrulate; in the stipules also being entire in their lower half; and especially in the areolæ being of a widely different shape, very minute and distinct. Fruiting specimens not seen.

Genus 24. **Fossombronia**, Raddi.

1. *F. macrophylla*, sp. nov.

Plant creeping, rather large, spreading 2–3 inches each way, overlapping, much and dichotomously branched, succulent, very fragile. Branches stoutish, dark-coloured, with many dark-purple long rootlets below; branchlets 4–9 lines long, usually naked above in the middle. Leaves sub-erect, crowded, wavy and rumpled, highly membranous, papillose, shining, green, sub-reniform-quinquangular, $2\frac{1}{2}$ lines broad above, sessile, amplexicaul laterally, margins sub-excised-sinuate, with about five small equidistant angles, sub-acute and minutely apiculate; tips of branchlets sub-rosulate; cells large, broadly-oblong and sub-orbicular-quadrate. Perianth large, erect, campanulate, open, wavy, margins slightly laciniate. Fruit-stalk erect, stout, 6–8 lines long, white; capsule globose, finely papillose, dark-purple; spores and elaters rich dark-brown; the helices of elaters minute and largely gibbous. On the capsule bursting, the broken shell is reflexed on the stalk, and the spores and elaters form a large globular ball.

Hab. Damp shaded spots, ravines, east slopes of Ruahine mountain range, County of Waipawa; 1885; *Mr. H. Hill.*

Obs. A species near to *F. nigricaulis*, Col.

Genus 28. **Podomitrium**, Mitten.

1. *P. smaragdinum.* sp. nov.

Plant dark-green, procumbent, of dense growth, slightly creeping, much and loosely overlapping and overgrowing; fronds

or lobes horizontal, drooping, scarcely sub-erect, very irregular, of various shapes and sizes, $\frac{1}{2}$ inch to 2 inches long, 2 lines broad, mostly ovate-acuminate and linear-ovate, obtuse and emarginate, sometimes stipitate, wavy and rumpled, smooth, shining; midrib stout, succulent, not clearly defined save at base, with fine, short, brown rootlets on the lower portion; margins thin, entire; frond much thicker on each side of the costa, tips often proliferous; sometimes several small fronds or lobes issue from a kind of flat rhachis, and then it possesses a somewhat sub-pinnatifid and forked appearance, lobes linear-acuminate; cells oblong, transverse. Fructification 1–3, from each side of midrib base of frond below. Involucre short, slightly tumid at base, with a few broad, obtuse, laciniate scales, shallow-cup-shaped, closely adhering, highly cellular, largely laciniate; laciniæ serrate, decurved. Perianth 3–3$\frac{1}{2}$ lines long, greenish with a purple-pink hue below, stout, slightly curved, smooth, shining, finely striate, cylindrical, narrowed and many plicate at apex, mouth laciniate; laciniæ long, slender, wavy; cells linear-oblong, barred. Fruit-stalks 1$\frac{1}{2}$–1$\frac{3}{4}$ inches long, stoutish. Capsule 1$\frac{1}{2}$ lines long, cylindrical, brown-purple, smooth, shining; valves linear, sub-acute, cohering strongly at tips after bursting; tips thickened; cells narrow-linear, thickened at ends. Elaters very numerous and long, twisted, enclosed, (somewhat like those of *Lejeunia* and *Pellia—teste* Dumort's figs.,) much implexed and crumpled, brownish, ends sub-acute; on the capsule bursting, the elaters remain in a largish globular, fluffy ball, covering the whole capsule. Spores orbicular, smooth, brownish-green, centre depressed, edges entire. *Male:* a few antheridiæ, sessile on each side of midrib below, under a broad sub-flabellate scale, margin sinuate and serrate, generally opposite in pairs and near the base, but sometimes on the stipe and sometimes scattered, 2–8 on a frond.

Not being satisfied with the comparatively low power of my own microscope, I applied to Dr. Spencer, who has an excellent and powerful compound one, (which he has also used so very effectually in describing the fresh-water *Algæ* of New Zealand in his papers in past volumes of "Trans. N.Z. Inst.,") and Dr. Spencer has very kindly examined the fruit, etc., of this little plant, and has also sent me the following interesting and copious description, which, with much pleasure, I bring forward here:—

"The elaters are very beautiful objects, they give one the idea of a double cord twisted into two helices; with a high power, a distinct but exceedingly fine membrane is seen surrounding the loops, not straight but following their sinuosities. The spores are circular, edges quite smooth, outline double, with cellular space between the two contours. Elaters, length $\frac{1}{80}''$, breadth $\frac{1}{1900}''$. Spores, breadth $\frac{1}{250}''$ to $\frac{1}{1900}''$." (Dr. Spencer *in litt.*)

Hab. On the earth at water's edge, in a deep, narrow, and dark glen (in which the sun never shines); forest, near Matamau, County of Waipawa (barren); 1883: and also in a swamp, in dense forest near Norsewood, same county (in fruit); 1885: *W.C.*

Obs. I. This species, though allied to *P. phyllanthus*, Mitt., differs pretty considerably from that plant, and that in several particulars—*i.e.*, from its description as given in "Flora N.Z.," and in the "Handbook Fl. N.Z.," and from the drawings and dissections of that plant, with description, as originally given by Sir W. J. Hooker in his "Musci Exotici." There is, however, another and similar plant, (discovered here in New Zealand by myself, and fully described by Hook. fil. and Taylor, in the "London Journal of Botany," 1844, as *Diplolæna cladorhizans;* and afterwards described in the "Synopsis Hepaticarum" as *Blyttia cladorhizans,*) to which this present one is very much more closely allied. But Mitten, in those two works on New Zealand Botany above named, has subsequently united those two plants (formerly "2 species and 2 genera") as being but one species: to this, however, I cannot agree. And it is worthy of notice that both Sir J. D. Hooker and Dr. Taylor, who well knew those two plants and published them, had considered them to be very distinct; although, from what they say, they evidently had not seen *Diplolæna cladorhizans* bearing perfect fruit: moreover, those able cryptogamists, the authors of the "Synopsis Hepaticarum," while disagreeing as to their being two genera, made two distinct species of them. For my own part, I think that Mitten has united two plants under his *Podomitrium phyllanthus* (l.c.), which, by his own showing there, might very easily be done. But be that as it may, of one thing I am pretty sure, that this plant I have now described in this paper is a very different one from that originally discovered in New Zealand (Dusky Bay) by Dr. Menzies, in 1791, and published by Sir W. J. Hooker in his "Musci Exotici" as *Jungermannia* (*Podomitrium*) *phyllanthus*.

Obs. II. This little novelty has caused me no little labour and research; for from my first detecting it in its darkish home (a deep rift in the earth at the head of a low forest gulley between two mountain spurs, a place, too, very dangerous of access, or, rather, to get out from, owing to its perpendicular and crumbling sides and nothing serviceable to lay hold of), I believed it to be something new; but it was barren, and not unlike other and known small frondose *Hepaticæ;* subsequently I sought flowering specimens in that spot but failed. I was much pleased in again unexpectedly meeting with it in a new locality, and beginning to show fruit! I brought a good sized portion carefully away, and in about a month it became fully developed.

Art. XLV.—*A brief List of some British Plants (Weeds) lately noticed, apparently of recent Introduction into this Part of the Colony; with a few Notes thereon.*

By W. Colenso, F.L.S., etc.

[*Read before the Hawke's Bay Philosophical Institute, 14th December,* 1885.]

In my travels or wanderings on foot during the last 2–3 years, mostly in and about the Seventy-mile Bush and its neighbouring localities, I have occasionally stumbled on a British plant that I had never seen before in New Zealand, that is since I left England, upwards of fifty years ago. On three occasions in particular I was at first, and for some time after detecting the plant, induced to believe that I had gained something additional to our indigenous Flora; but on examination, etc., I found out my mistake. I shall, however, only mention those few that are of recent introduction, at least here in Hawke's Bay; as far too much, in my opinion, has been already often said and repeatedly published respecting those British and Australian weeds, which have long been established in New Zealand, some of them even before it became a British colony! otherwise I might easily do as others have done before me: make out a long and wearisome reiteration or useless catalogue of hard names.

On the contrary (and as Sir J. D. Hooker in writing on this subject has shown), an increase of knowledge, if not a real benefit, is obtained, by noting the fact of the *introduction* or *first notice* of any of our Home and foreign common weeds into the colony.

Ranunculaceæ.

Ranunculus hirsutus, Curt. (Pale Hairy Crowfoot). Only *one* plant, and that a very large one, quite a little erect bush of above a foot high, containing very many flowers. (This is one of the three plants already alluded to, that on first sight I supposed to be indigenous, it had so much in common with our larger New Zealand *Ranunculi.*) In an open sunny watercourse near Norsewood; 1884.

Cruciferæ.

Coronopus didyma, Sm. (Wart Cress). A single plant only, but a pretty large prostrate one. This plant is not generally spread at Home, being confined to the south-west of England. I found this during the present summer (1885) at Napier.

Camelina sativa, Crantz. (Gold-of-Pleasure). Of this also I only detected a single plant, and that a few years ago near Napier; it was of large size (for the species) and full of flowers and fruit; I have not observed it since. I gathered and dried the whole of it. Its common English name seems wonderfully misplaced.

Lineæ.

Linum angustifolium, Huds. (Narrow-leaved pale Flax). First observed this summer here in Napier.

Hypericineæ.

Hypericum androsæmum, Linn. (Tutsan; Park-leaves). One fine plant only here at Napier, in my field; first observed at Christmas, 1884, bearing flowers and fruit.

Umbelliferæ.

Torilis nodosa, Sm. (Knotted Hedge Parsley). One small plant only seen, and that in a very strange out-of-the-way spot for a foreign weed to be found in, at the base of a high cliff, side of the River Mangatawhainui, Seventy-mile Bush; 1884. This little plant gave me some trouble; for, on my first meeting with it (young and leaves only), I supposed it to be *Daucus brachiatus*, Sieber, (an indigenous common northern plant that I had never met with in these parts,) or, something new; so I watched it carefully. On a subsequent visit I procured a tiny bit in flower, and on a still later visit its curious fruit, when I soon found out what it was.

Rubiaceæ.

Galium aparine, L. (Goose-grass, or Cleavers). This fine species of *Galium* grows strongly here at Napier. First noticed in 1884.

Compositaceæ.

Crepis pulchra, Linn. (Small flowered Hawk's Beard). Sparingly in my field at Napier.

Crepis tectorum, Linn. (Smooth Hawk's Beard). With preceding; this plant becomes a biennial in New Zealand. At first I had supposed this plant to be a *sp. nov.*, from its large size and woody stems, and being a perennial.

Hypochæris glabra, Linn. (Smooth Cat's-ear). With preceding; first noticed in 1884.

Lapsana communis, Linn. (Common Nipple-wort). In one spot only, in an open grassy glade in a thick wood, south of the River Mangatawhainui, near Norsewood; first noticed in 1883.

Arctium lappa, Linn. (Burdock; Clot-Bur). I first saw this plant in 1882, in a dense and unfrequented part of the Seventy-mile Bush. There was only one plant of it, a young one, having 2–3 large prostrate leaves resembling rhubarb. I could not tell what to make of it! I gazed on it with astonishment, much like Robinson Crusoe on seeing the print of a human foot in the sand! I had seen nothing like it in New Zealand. [To the best of my recollection I had never seen the burdock growing in England.] I visited that one plant several times during the first six months, with great expectations, but

could make nothing of it, as during that period it showed no signs of flowering. Subsequently, however, it flowered. I collected and dried specimens, and brought them to Napier, not, however, without some amount of misgiving. On due examination, I found out what it was. Unfortunately I did not go again to those localities until the following Spring; and, as it had seeded plentifully, and the cattle had got into that wood, they carried off its sticky burs in all directions; so that from that *one* plant hundreds have been disseminated, filling the neighbourhood with a much worse weed than the introduced thistle. Like many other of the foreign weeds, it flourishes exceedingly, and grows to a very large size, 4 feet high, thick, bushy and strong, insomuch that a few plants growing together offer quite an obstacle to the traveller that way.

Among sundry other plants of this extensive and easily introduced Order, that have also found their way here during the last few years, (although previously known in other parts of the colony,) may be mentioned :—

Chrysanthemum leucanthemum, Linn. (Great Ox-eye). In great quantity about Waipawa and Waipukurau, quite whitening the fields at Woburn with its flowers.

Achillea millefolium, Linn. (Common Yarrow or Milfoil). At Norsewood; where, however, it bears purple flowers, and looks well.

Centaurea solstitialis, Linn. (Yellow Star-thistle; St. Barnaby's Thistle). Napier.

Labiatæ.

Prunella vulgaris, Linn. (Self-heal). This weed, long known in the north of New Zealand, I first noticed about five years ago, and then only a few, and in two or three adjoining spots. When I first saw it, being young and only showing leaves, I did not recognise it. On a subsequent visit it was in flower. In the following year I was again sojourning in that same locality (Seventy-mile Bush), when one day a gentleman drove up to the house where I was; he had been up in the forest collecting ferns and plants for his garden, and among others he had carefully taken up some young *Prunella* plants; but on my telling him what they were, he quickly abandoned them. This plant, too, has spread wonderfully in a short time, supplanting, overrunning, and destroying the low indigenous herbs; which is the more easily done through it being a perennial.

Art. XLVI.—*On* Clianthus puniceus, *Sol.*

By W. Colenso, F.L.S., etc.

[*Read before the Hawke's Bay Philosophical Institute, 14th December*, 1885.]

For many years this truly handsome plant has at various times largely occupied my thoughts. Partly from its great beauty and comparative variety; partly from the large and cosmopolitan Order to which it naturally belongs, *Leguminosæ*, (so common in the neighbouring countries of Australia and Tasmania,) being so poorly represented in New Zealand; and partly from its genus being small and almost endemic. Indeed, I might go almost a step further, and add, that there is a kind of veil or mystery shrouding it, which hereafter may be clearly explained. In few words, that "mystery" is this: that I have never met with it growing truly wild and common, as all the other indigenous plants are found, although it may have been, like some of our genera, originally confined to one special area. Indeed, I think that, had it not been early raised from seed and generally cultivated by the colonists, (as well as at Home,) it would very nearly have become extinct, like some other New Zealand plants. And in this respect it seems to me to belong to that small class of esteemed plants that were long and assiduously cultivated by the ancient Maori people—viz.: the Taro (*Colocasia antiquorum*, Schott.), various sorts; the Kumara, or sweet potato (*Ipomœa chrysorhiza*), many varieties; the Aute (*Broussonetia papyrifera*), Paper Mulberry; the Tamure, or Awanga (*Phormium colensoi*), var., striped New Zealand Flax; and the Tipara (*Cordyline*, sp. undescribed), Broad-leaved Cabbage-tree. In one or two points, however, the *Clianthus* differs widely from them: (1) It bears seed abundantly; and, (2), it flourishes in almost all spots where it has been planted. Yet, in connection with this, I may observe that, although I have not unfrequently noticed a large shrub of *Clianthus* bearing hundreds of fruitful pods of seeds, that were left on the plant to ripen, burst, and fall to the ground, I have scarcely seen an instance of any of those many seeds springing spontaneously from beneath or around the parent plant; and this great peculiarity obtains also in a large measure among the *Phormium* species.

On my arrival in New Zealand, (Bay of Islands, 1834,) I first saw this fine plant in full bloom in the gardens of the missionaries; naturally I was struck with its imposing appearance, as I had never seen it, nor anything like it, before; indeed at that time it was scarcely known at Home. I very soon cultivated it in my own garden. In all my travels at the North, extending over several years, and crossing and recrossing the country in all directions, I never met with the *Clianthus* growing

wild or naturally, save on two or three of the smaller islets in that Bay,—notably on a small islet named Taranaki, in the mouth of the Kerikeri River. I have also seen it occasionally in deserted food plantations, and near the residences (occupied or abandoned) of the old Maoris; still it was a plant very well known among them.

The plant, however, was early seen in New Zealand by Cook and his co-voyagers, on his first voyage, and no doubt on this East Coast, and perhaps more than once at the different places where he touched and went on shore on that voyage, the time of the year being that of the flowering season of this plant—as at Tolaga Bay, Mercury Bay, and the Bay of Islands. Specimens of the plant were at that time taken Home by Sir Joseph Banks and Dr. Solander, and the plant was named *Clianthus puniceus* by Dr. Solander, who established its genus. Forster, who accompanied Cook on his second voyage, (and who has done so much towards making known the botany of this country,) probably never saw it, although here in the proper season for observing it, as his visits were confined to the South Island, where, I have reasons for believing, the plant was not originally found. The more modern botanists, also, as Lesson and Raoul, whose researches and discoveries were mainly confined to the South Island, make no mention in their works of having met with it; and the two Cunninghams, who were also early in New Zealand at the North, and who spent some time there (especially Richard Cunningham), also never saw it.

However, it was first published by George Don, in 1832, in his "General System of Botany," who changed its original name of *Clianthus* (known also to him) to *Donia punicea*. His description of the plant is a good one (a portion of its character I extract):—"*Vexillum* ovate-lanceolate, acuminate, rather shorter than the keel, reflexed; *Wings* lanceolate, acuminate, half the length of the keel," etc. "Native of New Zealand, where it was first discovered by Sir Joseph Banks and Dr. Solander, who gave it the name of *Clianthus puniceus*." (*loc. cit.*, vol. ii., p. 468.) Of course, Don could only have known of those New Zealand specimens from which he drew up his description; he does not say why he changed the name of the plant given to it by its discoverer, which, curiously enough, he also gave *his own name* to! though he says it was "named in honour of Mr. George Don, of Forfar," his own father.

This was followed by Dr. Lindley, in 1834, in a more elaborate account of this plant, in a paper "read December 2, 1834," before the Horticultural Society of London, and published in 1835, in their "Transactions," 2nd series, vol. i., p. 519, accompanied with a large and well executed coloured drawing of it, from the pencil of the celebrated flower painter, Miss Drake. This drawing, I may further observe, was taken from

a fresh specimen of the plant "raised in England from seed gathered by the missionaries in New Zealand, where it is said to be called 'Kowhaingutu-kaka,' or Parrot's-bill, and to grow to the size of a large tree" (*sic*)—"in England, however, it has not reached beyond 4 feet in height." The coloured drawing of the plant is a bold, clear, and good one, and shows the flowers much as Don had described them, with their "wings lanceolate and acuminate." At that time Dr. Lindley restored to the plant its original name of *Clianthus puniceus*, which it has properly retained ever since.

During my early visits to the East Coast, but always late in the summer, (1838–1843,) landing at Wharekahika (Hicks' Bay), and travelling on foot to Poverty Bay, in and out among the Maori villages, I noticed a few scattered plants of *Clianthus*, though much as I had formerly seen them in the North.

In 1844 I came to Hawke's Bay (second time) to permanently reside, and it was not very long before I obtained plants of *Clianthus* (from seed or cuttings) from the Maoris for my garden. In due time, when these grew and flowered, I noticed a marked difference between their flowers and those of the northern plant, with which I was so well acquainted. At first I did not pay great attention to it, having vastly too much of other and more important matters to attend to, but in course of time, and as my plants grew so tall and to such a large size, I examined them a little more closely, and then I discovered what I believed to be a true specific difference, or, at all events, showing a marked variety, if the newly-detected characters should prove constant. Somewhere in the decade of 1840, I sent specimens of this southern form of *Clianthus* (with other plants) to Kew, to Sir W. J. Hooker, calling his attention to the differences I had noticed; in the course of (say) the following year, Sir W. J. Hooker, in reply, said that they at Home who had examined the dried specimens sent could not detect any material difference.

After that time the matter slept, as far as I was concerned. Of late years, however, having the southern form (as I call it) always here in my own garden, and seeing it generally plentifully cultivated in gardens in this town, and in the adjacent country villages and other places, I have been led again to closely examine the plant, and I have found that those differences I had formerly detected still continued. I, therefore, obtained both seeds and plants of the northern form from Auckland, and this year the plants have flowered in my garden; and now, having the opportunity of comparing closely the two forms in a living state, I give briefly the result of my old and new examinations, which will serve sufficiently to point them out.

1. *Clianthus puniceus*, Sol. (*vera*: N. form).

Flower 3 inches long, $1\frac{1}{4}$ inch broad; standard ovate, very

acuminate, sides nearly straight, claw long; wings lanceolate, acuminate, acute; colour a clear lively scarlet.

2. *Clianthus maximus*, Col. (S. form).

Flower 2–2¼ inches long, 1½ inches broad; standard broadly ovate, acuminate, sides rounded, claw short; wings somewhat oblong, broad, very obtuse (rounded) at apex; colour a less clear red, verging to more of a dark or crimson hue, with a large dark spreading blotch at base of the standard; flower broader; and the substance of the petals, especially the keel, thicker, more coriaceous or skinny, and finely wrinkled. The leaves also of this species are larger, some leaflets measuring more than two inches; these are also more membranous and glabrous than in the northern form; and the whole plant is stouter, rises higher, generally from 6 to 10, or even 12, feet.

The principal differences, however, which are clearly apparent at first sight, (especially if the flowers of the two forms are compared together in a living state), consist in their relative sizes, in the shape of their standards, and more especially in their wings, and also in their colours; but whether those differences, though constant, are sufficient to constitute two separate species, or merely varieties, is of little consequence to me—the two forms exist.

And here I may further remark (having very frequently of late years noticed it), that several of our indigenous New Zealand plants, and in particular of genera of which it had always been believed that New Zealand possessed but *one* species of each genus, have now, at least, *two* species to each genus; or if not exactly (and beyond all controversy) two species, seeing that the limit of a species can scarcely be clearly defined, then two forms; the southern form being very distinct from the northern one, yet pretty closely resembling it in general appearance. And this I have especially noticed to take place in the Orchid Order: *e.g.* Dendrobium, Sarcochilus, Bolbophyllum, Gastrodia, Earina, Microtis, and Orthoceras; to which may be added Gratiola, Dianella, Arthropodium, Tupeia, Australina, Hoheria, and many others.

To this mysterious subject, however, of dimorphism (found here again in *Clianthus*), I hope to return on some future occasion.

In conclusion, I may add, that Lindley's description of *Clianthus puniceus* agrees with the coloured drawing of the English cultivated one already referred to, in which the *alæ* or wings are correctly shown to be lanceolate acuminate with acute tips. A. Cunningham's description of the same, in his "Prodromus Novæ Zealandiæ," (published several years after, 1839), in "Annals of Natural History," vol. iii., p. 246), is drawn, as he shows, from two sources, the one being "Solander's MSS,

in Bibl. Banks," and the other Dr. Lindley's description already mentioned; as at that time of Cunningham's writing his valuable paper in England, he had not seen the plant growing in New Zealand,—although he did afterwards in my garden and elsewhere. Sir D. Hooker, in his "Flora Novæ Zelandiæ," in describing *Clianthus puniceus* gives the following: (1. of the genus), "*Vexillum* ovatum, incumbens v. reflexum, carinam oblongam cymbiformem æquans: *alæ* lanceolatæ, basi exciso auriculatæ, carina breviores:" and (2. of this species), "*Standard* ovate, slightly recurved, as long as the keel. *Wings* lanceolate, sub-falcate, sharp, twice as long as the standard, 1½ - 2 inches long." Here, however, while his description of the shape of the wings is quite correct, and in agreement with both Don and Lindley, above, viz., "*Wings* lanceolate, sharp;" there is a manifest error with regard to their size—"twice as long as the standard." This latter is corrected in his "Handbook," published several years after (1864), and altered to "half as long as the standard;" while the former description of the shape of the tips of the wings is also altered from "sharp" to "acute *or obtuse;*" evidently, as I think, to embrace the two states or forms (whether species or varieties) to which I had early called his attention.

Napier, December 10th, 1885.

P.S.—Living flowers of both plants, with mounted dissections showing the diverse forms of their parts, as described in this paper, were exhibited at the ordinary meeting of the Hawke's Bay Philosophical Institute in October, 1885.—W.C.

ART. XLVII.—*Description of New Species of Native Plants.*

By D. PETRIE, M.A.

[*Read before the Otago Institute, 9th June, 1885.*]

Cotula goyeni, n. sp.

A MINUTE, prostrate, creeping herb.

Stems very short, clothed by the leaves, and woolly below their insertion.

Leaves broadly-oblong, $\frac{1}{6}$ - $\frac{1}{5}$ inch long; upper half cut into 5–7 linear lobes directed forwards, greyish-green; lower half entire, membranous, scarious, 1-nerved, more or less pubescent on the margin and outer surface.

Heads small, subsessile or sessile at the tips of the branches; peduncles very short (rarely exceeding $\frac{1}{8}$ inch), woolly or pubescent; bracts in one or two series, ovate-oblong, obtuse, dark-purple at the edges: outer florets, female in one series; inner hermaphrodite; style crowned by a thin disc-like flattened stigma, in both female and hermaphrodite flowers; stamens

exserted, and style still larger than the stamens. Achene not seen in the mature form, but apparently glabrous.

Hab. Old Man Range, 5,000 feet; and Mount Pisa, 5,000 to 6,000 feet.

A very peculiar species, having considerable affinity to *C. pectinata*, Hook. fil. The most remarkable point in its structure is the capital flat-topped stigma, which is common to both kinds of flowers. In some specimens the stigmatic disc shows traces of a division into two lobes, but I have seen none with anything like two branches to the style. *Cotula maniototo* (mihi) in this respect approaches the present species, for in all its hermaphrodite flowers the stigma is capital and flat-topped. The flowers of the outer row, on the other hand, have in *C. maniototo* two short arms to the style.

If this peculiarity should prove constant in the present species, and it should continue to be regarded as a *Cotula*, the character of the genus as now formulated will require modification. I was unfortunately unable to procure mature achenes, as my specimens were gathered about the middle of February; the mature fruit might be got in March. The plant is very common on the top of the Mount Pisa Range, and less so on the Old Man Range, above Deep Creek.

Myosotis cheesemanii, n. sp.

A small, branched, hispid perennial.

Stems several, slender, ascending, about 1 inch in length, densely hispid.

Radical leaves 7–9 lines long, spathulate-oblong, acute, 3-nerved near the base, the upper half coriaceous, the lower membranous, everywhere densely hispid with appressed stiff hairs, except on the lower third on the inner face, which is glabrous.

Cauline leaves similar, but narrower, shorter, and more acute.

Flowers, 1–4 on each stem, solitary or in pairs in the axils of the upper leaves, shortly pedicelled, 5 lines in length.

Calyx densely hispid with appressed hairs, shortly 5-lobed, the lobes acute.

Corolla white, the tube twice as long as the calyx, limb about 3 lines across.

Anthers not exserted, style projecting nearly one line beyond the corolla.

Nuts in pairs, narrow-ovate, lenticular, smooth and polished, dark-brown, with narrow wing-like ridges.

Hab. Mount Pisa Range (6,000 feet), on steep faces of shingle above the snow-drifts.

A most beautiful little plant. The flowers are conspicuous, and large for so small a plant. They have also a strong and agreeable odour, and are much frequented by insects, by which

their fertilisation is doubtless effected. I have much pleasure in dedicating the species to Mr. T. F. Cheeseman, F.L.S., who has done much to elucidate the New Zealand species of the genus.

I have a form of this species from Mount St. Bathan's (4,500 feet); and Mr. G. M. Thomson informs me that he has gathered the same on the Rock and Pillar Range at an altitude of 4,000 feet.

Carix berggreni, n. sp.

Small, loosely tufted, reddish-brown.

Culms very short, 1¼ – 2 inches long, flattened above, shorter than the leaves, and enclosed to the base of the head by thin broad sheathing bases.

Leaves red-brown, 2–3 inches long, flat linear, of uniform width throughout the blade, obtuse, not serrate, finely and closely striate; bases paler, membranous, sheathing, twice as broad as the blade.

Spikelets 3, unisexual; two lower female, uppermost wholly male, approximate, stout, each 3 lines long, on short slender pedicels; bracts leaf-like, sheathing, diminishing in the upper spikelets.

Glumes broadly-ovate, shorter than the utricles, membranous, obtuse, rarely mucronate, entire, 1-nerved, with dark-brown streaks and blotches.

Utricles turgid, bi-convex, elliptic-oblong, not beaked, shortly bifid, spreading, very faintly nerved, dark-brown or black above, elsewhere green.

Branches of the style, 2. Fruit, 3-angled.

Hab. Mount Pisa Range, at the head-waters of the Luggate Creek, 4,000 to 5,000 feet.

This is a most distinct species. It is most nearly related to *C. uncifolia*, Cheeseman, but its short red-brown obtuse ensiform leaves readily distinguish it from all its congeners in New Zealand. The male spikelet is somewhat larger than and not so stout as the female ones. Named in honour of Dr. Sven Berggren, of Upsala University, who has described and figured several New Zealand species of the genus.

Carex kirkii, n. sp.

Small, densely tufted, grass-like; forming low tussocks 1–2½ feet in diameter.

Culms ½ – 1 inch long, very slender, much shorter than the leaves, and enclosed in their sheathing bases.

Leaves 3–5 inches long, filiform, involute, slightly striate, pale-green, with short broad membranous sheathing bases.

Spikelets 3–5, forming a compact ovoid head 6–9 lines long, sessile, closely approximate, female below, male above, few-flowered; bracts variable, the lowermost usually leaf-like, the upper glume-like, all shortly sheathing at the base.

Glumes ovate-lanceolate, acute, entire, membranous, pale at the top and edges with prominent green midrib, slightly larger than the utricles.

Utricles ovate-lanceolate, plane-convex or concave-convex, sub-stipitate, many-nerved, with recurved wings and tapering, bifid, serrate beak.

Branches of the style, 2, long.

Hab. Mount Pisa Range, at the head-waters of the Luggate Creek, 4,000 to 5,000 feet. Male flowers are sometimes absent in the lowermost spikelet. The foliage, though somewhat harsh, is readily eaten by sheep.

This species is allied to *C. muelleri*, mihi, = *C. viridis*, mihi, and *C. kaloides* (mihi). Named in honour of Mr. T. Kirk, F.L.S., a veteran worker in the Flora of New Zealand.

Carex thomsoni, n. sp.

Small, tufted, pale-green.

Culms very short, $\frac{1}{2}-\frac{3}{4}$ inch long, much shorter than the leaves, and invested by thin sheathing bases.

Leaves $1\frac{1}{2}-2$ inches long, linear, tapering upwards, acute, flat, deeply striate, finely serrate towards the top, their bases membranous, sheathing, and twice as broad as the blade.

Spikelets 3, crowded, female below, male above, forming a compact head $\frac{1}{4}-\frac{1}{3}$ inch long; bract short, ovate, mucronate.

Glumes ovate, acute, 3-nerved at the middle, membranous, entire, dark-brown at the margin, as long as the utricle.

Utricles lenticular, ovate or elliptical, broadly winged, shortly stipitate, nerved, with bifid beak, the upper half finely serrate.

Arms of the style, 2.

Hab. Mount Pisa Range, 5,500 to 6,200 feet.

The male flowers occur chiefly at the top of the uppermost spikelet; they are rare on the lowermost, less so on the middle one. The plant forms small low tufts, 3–5 inches in diameter. Flowering or fruiting specimens are not by any means easy to find. It is very common in the most exposed situations on the very crown of this wind-swept range.

Named in honour of Mr. G. M. Thomson, F.L.S., of Dunedin.

Carex muelleri = *C. viridis*, mihi.

My friend Sir Ferdinand von Mueller has pointed out to me that the specific name *viridis*, which I attached to a species of *Carex* described in vol. xiii. of the "Transactions of the New Zealand Institute," has been already used to designate a plant from Mexico. I have now very great pleasure in associating the name of that distinguished botanist with this interesting plant, in recognition of his great services to the science and of many kindnesses to myself.

ART. XLVIII.—*On the Classification of the* Algæ.

By R. M. LAING, M.A.

[*Read before the Philosophical Institute of Canterbury, 6th August*, 1885.]

Plate XA.

MANY attempts to classify the *Algæ* have been made, and though of late years our knowledge of this division of plants has greatly increased, yet it cannot be said that their relationships to each other have been satisfactorily made out. The older botanists were content with dividing them into two genera, *Conferva* including all fresh, and *Fucus* including all salt water forms. Harvey was the first to divide them into three groups, according to the supposed colour of their spores, thus: *Chlorospermeæ* (green-spored), *Melanospermeæ* (olive-spored), *Rhodospermeæ* (red-spored). In these divisions he has been followed by Sir J. D. Hooker, up to the present day.

Decaisne divided the *Algæ* into *Synsporeæ* (united spores, the modern *Conjugateæ*), *Aplosporeæ* (spores simple, not motile, green or brown), *Choristosporeæ* (separated spores, motionless, red, developed in fours). The next classification was that of Thuret; his divisions are well known: (1.) *Zoosporeæ*, (2.) *Chlorosporeæ*, (3.) *Phæosporeæ*, (4.) *Fucaceæ*, and (5.) *Florideæ*. In 1872, Cohn proposed to abolish the distinction between *Algæ* and *Fungi*, and form them into parallel lines. In 1875, Sachs said the classification of the *Algæ* was in the utmost confusion. He gave a new classification, improved upon in 1882, grouping the different divisions of the *Algæ* thus:—

Class A.—PROTOPHYTA.
- I. *Cyanophycaceæ*. (*Phycochromaceæ*, Prantl.
- II. *Palmellaceæ* (in part).

Class B.—ZYGOSPOREÆ.
- I. *Pandorineæ*.
- II. *Conjugateæ*.

Class C.—OOSPOREÆ.
- I. *Sphæroplea*
- II. *Cœloblasteæ*
- III. *Œdogonieæ* } Product of fertilization, a resting spore.
- IV. *Fucoideæ* { Product of fertilization, a new individual.

Class D.—CARPOSPOREÆ.
- I. *Coleochæteæ*.
- II. *Florideæ*.
- III. *Characeæ*.

In 1880, Mr. A. W. Bennett, in a paper read at the Swansea meeting of the British Association, proposed the following classification :—

THALLOPHYTES.

I. *Protophyta* { *Protomycetes.* / *Protophycaceæ.*

II. *Fungi* { *Zygomycetes.* / *Oomycetes.* / *Carpomycetes.*

III. *Algæ* { *Zygophyceæ.* / *Oophyceæ.* / *Carpophyceæ.*

Then he proposes to subdivide the *Zygophyceæ*, the *Oophyceæ*, and the *Carpophyceæ* thus :—

A. ZYGOPHYCEÆ.

1. *Pandorineæ.*
2. *Hydrodictyeæ.*
3. *Confervaceæ.*
4. *Ulotrichaceæ.*
5. *Ulvaceæ.*
6. *Botrydiaceæ.*
7. *Conjugateæ.*

B. OOPHYCEÆ.

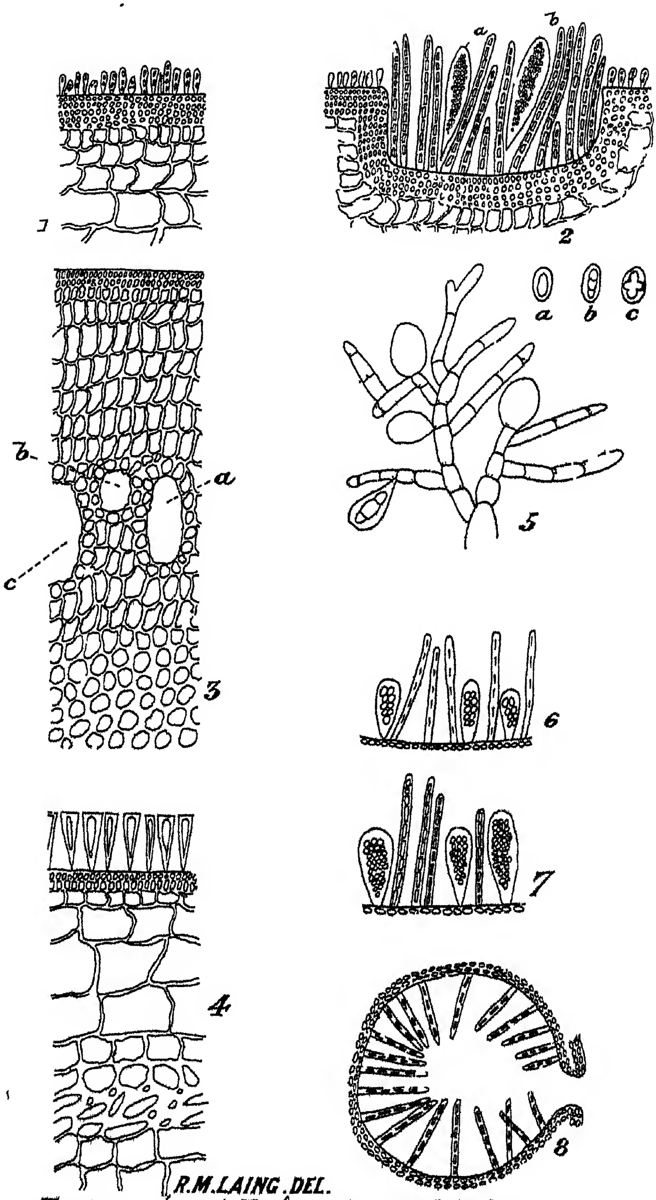
1. *Volvocineæ.*
2. *Siphoneæ.*
3. *Sphæro-pleaceæ.*
4. *Œdogoniaceæ.*
5. *Fucaceæ.*
6. *Phæosporeæ.*

C. CARPOPHYCEÆ.

1. *Coleochæteæ.*
2. *Florideæ.*

The earlier classifications need not be considered, as they will doubtless be superseded by those of Sachs and Bennett. But even the systems of these two last mentioned botanists appear to me to be open to several objections.

(1st.) By both, the *Phæosporeæ* are placed amongst *Oosporeæ*, though probably nearly all of them are reproduced by conjugation. (2nd.) Again, by both the *Hydrodictyeæ* are separated from their nearest allies, the *Volvocineæ*. (3rd.) Sachs places the *Botrydiaceæ* under the *Oosporeæ*, but conjugation alone is known in them; while Mr. Bennett separates them widely from the *Siphoneæ*, which are undeniably their nearest relations.



To accompany Paper by R.M.Laing.

(4th.) The *Confervaceæ* are widely separated from the *Sphæropleæ* by both Sachs and Bennett; but these two orders differ only in their mode of reproduction, whilst they closely resemble each other in general structure and appearance.

It seems to me that the principal cause of error in these two classifications is the idea that all the *Oosporeæ* must be closely related, for behind this idea is the belief that fertilization has arisen only once in the vegetable kingdom; that is to say, that all plants which are reproduced by fertilization are descended from a common stock. But this scarcely appears to me to be correct, for fertilization has evidently arisen independently in the animal and vegetable kingdoms, as it is not found in the *Protozoa*, or the *Palmellaceæ*, the lowest divisions of each kingdom. Again, looking at the *Algæ* themselves, we see that fertilization is not the same process in all. The oospheres of *Fucus*, for example, differ considerably from the oospheres of *Vaucheria;* but, at the same time, the structure of the stem in the two genera is totally dissimilar. Now, it is much easier to suppose that fertilization has arisen independently in these two groups, than that they have diverged from a common ancestor, reproducing itself in this way. For it can scarcely be doubted that fertilization first originated in conjugating zoospores. We have only to suppose (and the supposition is perfectly warrantable) that an advantage was gained by a specialization of the functions of the two cells; the one increasing in size and becoming passive, the other remaining small and motile, since it would have to penetrate into the interior of its companion cell. Through some such variation as this, fertilization might easily have arisen on various occasions.

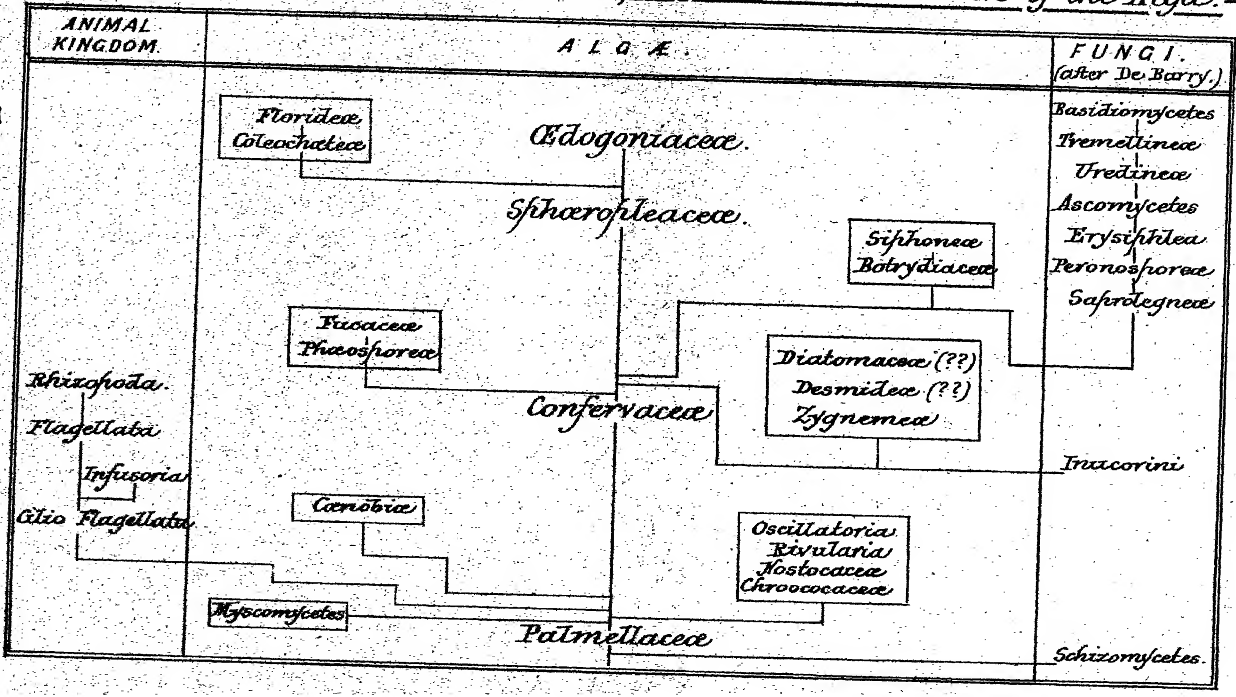
One more objection might be taken to Sachs' classification of the *Algæ*. He has included the *Characeæ* under the *Carposporeæ;* though it appears probable that they should stand by themselves. Perhaps they are degenerate forms of a higher type; for it is only in habit and, to some extent, in structure of stem, that they at all resemble the *Algæ*; and we know that many fresh-water plants have become much simplified in structure (*e.g. Marsilia* and many of the *Naiadeæ*). A plant living in water has no need for a stem built up of many tissues. The simplicity of the stem of *Chara* does not necessarily therefore connect it with the *Algæ*, and its reproduction, on the other hand, can scarcely be compared with that of the *Florideæ* and *Coleochæteæ*. Professor Sachs has endeavoured to trace out homologies between the two, which, however, to me appear to be far-fetched and doubtful. It is much easier to suppose that the *Characeæ* is an order standing by itself, than to consider it as allied either to the *Algæ* or the *Musci*. Mr. Bennett has well dealt with this question in the "Journal of Botany," 1878, p. 202; so it will not be necessary to go into any detail here.

As a lineal classification of the *Thallophytes* is impossible, I would tabulate them thus, the orders of the *Algæ* being given in full:—

Class.	Sub-Class.	Orders. Cell Division.	Orders. Zoospores.	Orders. Oospores.	Orders. Zygosperms.
A. Protophyta.	Palmellaceæ. Cyanophyceæ. Schizomycetes.	Palmellaceæ. Cyanophyceæ. Schizomycetes.	Palmellaceæ. Cyanophyceæ.		
B. Algæ.	Conjugatæ.	..	..	..	Desmideæ. Diatomaceæ. Zygnemeæ.
	Cœnobiæ.	..	Hydrodicteæ.	Volvocineæ.	
	Confervoideæ.	Confervaceæ (?).	Confervaceæ. Ulvaceæ.	Sphæropleæ. Œdogonieæ.	
	Cœloblasteæ.	..	Botrydiaceæ.	Siphoneæ.	
	Melanophyceæ.	..	Phæosporeæ.	Fucaceæ.	
	Carposporeæ.	..	..	Coleochæteæ. Florideæ.	
C. Fungi.					

The genealogical tree on Plate Xa. seems to me to show, as nearly as our present knowledge will permit, the genetic affinities of the different orders of the *Algæ*. Of course, much of it is provisional and somewhat doubtful. For example, I have placed the *Palmellaceæ* as the lowest group, but this position may belong

Genealogical Table shewing Relationships of the different Orders of the Algæ.



To illustrate Paper by R. M. Laing.

to the *Chroococaceæ.* Again the *Myxomycetes* are placed in the vegetable kingdom; but there is no more reason for placing them there than in the animal kingdom. The position of the *Conjugateæ*, too, is very doubtful, and it seems not unlikely that the *Zygnemeæ* will have to be separated from the *Diatoms* and *Desmids.* Fertilisation I conceive to have originated in four different orders: the *Fucaceæ*, the *Cœnobiæ*, the *Sphæropleæ*, and the *Siphoneæ.* (These are underlined.)

ART. XLIX.—*Observations on the* Fucoideæ *of Banks Peninsula.*

By R. M. LAING, M.A.

[*Read before the Philosophical Institute of Canterbury, 6th August,* 1885.]

Plate X.

THE brown seaweeds must always be an interesting group of plants to the botanist, on account of the exceptional facilities they offer for the investigation of the phenomena of fertilisation and sexual reproduction. The New Zealand genera are especially attractive, because of their great diversity of form and structure.

The first collection of these was made by Mr. Menzies, surgeon to Captain Vancouver's expedition. All his specimens are from Dusky Bay, in the south-west coast of Otago. They were described about the end of the last century. Prior to this time, however, a few marine *Algæ*, common to New Zealand and other southern regions, had been incidentally named by previous visitors to the Australasian seas. Banks and Solander had roughly described one or two of the more conspicuous species. The first systematic collection, however, was made between the years 1821 and 1825, by Bory, one of the naturalists of the French ship *Coquille.* He described about a dozen species of the *Fucoideæ* from various parts of New Zealand. He was followed by Messrs. Lesson and Richard, naturalists of the French ship *Astrolabe.* They contributed three or four new species to the list of those already known. A considerable number of specimens obtained during the second voyage of the *Astrolabe* were described by Montaigne in 1845; and about 1840 a very large collection of New Zealand plants was made by Sir J. Hooker, botanist to the *Erebus* and *Terror* expedition. The *Fucoideæ* obtained by him, to the number of about fifty, were described in "Flora Novæ Zelandiæ."

But by this time a large synonymy had grown up around the nomenclature of the New Zealand seaweeds, partly owing to the same species being described from different coasts under different names, and partly owing to the independent description of collections sent home to English and continental naturalists. Agardh, Turner, Kuetzing, and Lamoureux had all at various times described and named species of seaweeds found in the

southern seas. The confusion that had thus arisen with regard to specific names was much lessened by the appearance of Hooker's "Handbook of the New Zealand Flora" in 1864. The number of brown seaweeds there described is fifty-eight. Almost nothing was done after the publication of this standard work in the way of arranging and classifying the New Zealand *Algæ*, until Dr. Berggren of Lund University made a collection in 1876. His specimens were examined by J. S. Agardh, who published a revised catalogue of New Zealand marine *Algæ*, reducing the number of *Fucoideæ* to fifty-two. Many of the specific names of Hooker were altered, and a few species were united and others cast out. It is, therefore, very difficult for me in many cases to determine the true specific name with certainty, especially as I can only refer to the works of a few of the elder algologists. Therefore, in the following paper, where the name is doubtful I have given it both, as it is in Hooker's Handbook and Agardh's Catalogue. In the "Transactions of the New Zealand Institute" for 1879 there appeared a list of the seaweeds of Canterbury, but as it was evidently only a compilation from Hooker, I will not refer to it further.

The following is a list of the *Fucoideæ* that have as yet been found at Banks Peninsula:—

1. *Ectocarpus siliculosus.* (Lyngbye.)
2. *Sphacelaria paniculata.* (Suhr.)
3. ,, *funicularis.* (Mont.)
4. *Asperococcus sinuosus.* (Bory.)
5. *Zonaria velutina.* (Harvey.)
6. *Desmarestia ligulata.* (Lamoureux.)
7. *Adenocystis lessonii.* (Harvey.)
8. *Ecklonia radiata.* (J. Agardh.)
9. { *Macrocystis dubenii.* (Aresch.)
   { ,, *pyrifera.* (Agardh.)
10. *D'Urvillea utilis.* (Bory.)
11. *Notheia anomala.* (Bailly and Harvey.)
12. { *Hormosira banksii.* (Harv.)
    { ,, *labillardieri.* (Mont.)
13. *Splachnidium rugosum.* (Greville.)
14. *Cystophora scalaris.* (Ag. Mss.)
15. ,, *retroflexa.* (Ag. Sp. Alg.)
16. ,, *dumosa.* (Ag. Mss.)
17. ,, *torulosa.* (Ag. Sp. Alg.)
18. *Fucoidium chondrophyllum.* (Agardh.)
19. *Carpophyllum maschalocarpum.* (Agardh.)
20. *Marginaria boryana.* (Rich.)
21. ,, *urvilleana.* (Rich.)
22. *Sargassum raoulii.* (Harvey.)
23. ,, *sinclairii.* (Harvey.)

OBSERVATIONS.

1. *Ectocarpus siliculosus.*

In Hooker's description of this there is an evident misprint, the length being put down as $\frac{1}{12}$ inch instead of 12 inches.

I have at present no remarks to offer on—

2. *Sphacelaria paniculata.*
3. ,, *funicularis.*
4. *Asperococcus sinuosus.*
5. *Zonaria velutina ;* and
6. *Desmarestia ligulata.*
7. *Adenocystis lessonii.*

Hooker's description is: "Root, a small disk or shield. Frond a dull green or olive-brown, membranous, pyriform sac, on a slender short stalk, hollow or full of water, coated with a thin layer of vertical clavate articulate filaments. Spores pedicelled, pyriform, attached to the base of the filaments and scattered over the whole frond."

Fig. 1 shows a transverse section through the bladder-wall, which consists of two tissues, a narrow epidermal layer of small coloured cells, and an inner layer of oblong colourless cells. From the latter spring long jointed hairs, covering the interior of the bladder and giving it a slightly downy appearance. They are generally colourless, but sometimes contain colouring matter aggregated into more or less rounded masses.

The reproductive organs of this little plant are very interesting, because it seems to possess two kinds of zoogonidia. Thuret ("Ann. de Sc. Nat. Bot.," 1850, p. 235) has described the same occurrence in various other genera of the *Phæosporeæ*. Harvey, ("Phycologica Australica," Pl. xlviii.) says that, in addition to the ordinary fructification on the surface of the bladder, "the frond of *Adenocystis* is dotted with hemispherical gland-like spots, from which lyssoid filaments issue, and which may be possibly connected with antheridia." I have made a large number of sections of these conceptacles (the gland-like spots of Harvey,) without obtaining any very definite results. Fig. 2 shows the most successful of these sections. In it appear two large cells, (Fig. 2, *a.* and *b.*) which perhaps contain zoogonidia. I was not, however, able to determine the position of attachment of these cells.

The conceptacles appear in very young specimens, and consequently I have not been able to ascertain anything about their mode of development; but, judging from the fact that the epidermal tissue passes round the whole conceptacle, it would appear to be the result of invagination alone. Thus it would not be altogether homologous to the conceptacle of the *Fucaceæ*, which,

according to Mr. F. O. Bower, ("Jour. Mic. Sc.," Jan., 1880,) is partly formed by invagination, and partly by deliquescence. In *Adenocystis*, too, these conceptacles are as wide at the mouth as at the base; but in most, if not in all the *Fucaceæ*, the aperture of the fertile conceptacle is much narrower than the interior. The conceptacle of *Adenocystis*, therefore, may be homologous to the "Fasergrübchen" of *Alaria esculenta* and *Fucus platycarpus*. (*Vide* Keutz. "Phycologica Generalis," p. 92.)

When young, the frond of *Adenocystis* is dotted over with tufts of colourless hairs, which encircle the mouths of the conceptacles. A transverse section through the bladder-wall of a not fully matured specimen, shows the frond to be covered with short clavate bodies, in which the cell contents are aggregated together into several distinct masses. It is to these Hooker refers, when he says that "the frond is coated with a thin layer of vertical clavate articulate filaments." A section through the frond of a mature specimen shows it to be covered with three different kinds of bodies :—

(*a*.) A number of short clavate filaments, similar to those already mentioned.

(*b*.) Somewhat longer jointed hairs, probably developed from (*a*).

(*c*.) Oval sacs, containing zoogonidia (?)

These are all represented in fig. 1.

The plant is a common annual, found chiefly in tidal pools. It cannot be obtained during the months of June, July, and August.

8. *Ecklonia radiata*.

The generic description in the "Handbook of New Zealand Flora" is: "Root scutate or dividing into short fibres. Frond olive-green, pinnatifid, ecostate, segments produced from the magnified teeth of a simple lamina, which is contracted to a solid or inflated stem at the base. Sori superficial on the lower part of the pinnæ of narrow ellipsoid spores, mixed with clavate inarticulate filaments." (*Sp. radiata*:) "Frond 1–2 feet long, stem solid or sparingly inflated."

The stem consists of three tissues: an epidermal layer of coloured cells, a second layer of parenchymatous tissue, and a third of loose cells, lying in mucilage. In the second tissue, just beneath the epidermal cells, there is a circular ring of longitudinal "secretion canals," which probably act as conducting or storing vessels for the mucilage; for when a fresh stem is cut through, mucilage exudes from them in considerable quantity. These canals are formed by the splitting away of adjacent cells, and appear first as small irregularly shaped openings in the tissue, some distance from the apex of the frond. As they increase in

size, they are cut off from the surrounding tissue by a ring of small cells. The third tissue consists of anastomosing filaments which have no particular direction with regard to the axis of the plant.

Reproduction by zoogonidia, developed in sporangia,* closely packed together on the lower portions of the frond. The "clavate, inarticulate filaments" of the Handbook are probably young sporangia. I have not as yet been able to see the zoogonidia escape. It is worthy of notice that the sporangia are developed in corresponding patches on both sides of the frond.

Common, just below low water-mark.

9. *Macrocystis dubenii.*

Description in Hooker's "Handbook of New Zealand Flora" (*Generic:*) "Root branching, giving off immensely long, slender, simple stems, which bear leaves at the surface of the water. Leaves formed by the continual splitting of a primary terminal leaf, developed in secund order along the lengthening floating stem, each lanceolate, serrate, ribless, undulate, with a pyriform-oblong or sub-cylindric bladder at its base. Spores superficial on submerged radical leaves, forming clouded sori, ellipsoid with a hyaline coat, surrounded by densely-packed inarticulate paranemata." (*Sp.*) "Stems, 50 to perhaps 700 feet long or upwards. Fronds extremely variable in length and breadth, 2–4 feet long, 2–6 inches broad, ciliate-serrate."

It is wrongly here stated that the stems are simple. They branch dichotomously, but only immediately above the rhizoid. The length of the stem has been variously stated; and it is generally said to be the longest plant in the world. In Lyttelton Harbour, however, it certainly does not attain a greater length than 70 feet; commonly it is from 20 to 30 feet long. In structure the stem is very similar to that of *Ecklonia*. The secretion canals are present, and originate in the stem, at some distance below the apical leaf. In the "Transactions of the New Zealand Institute," vol. xiv., p. 562, it is said: "Professor Parker exhibited and made remarks upon sections of the stem of *Macrocystis*, showing sieve tubes like those of *Cucurbita*." This doubtless refers to the anastomosing cells of the central tissue, which sometimes closely resemble the sieve tubes of *Cucurbita*, as figured by Sachs.

The bladders are formed by the central tissue ceasing to grow, whilst the external tissues develope rapidly; and, consequently, the stem at this point swells outward, and at last tears apart the filaments of the central tissue, which are left hanging

*I am compelled to use the incorrect term "sporangia," as there is no other English word which can be made to express the idea "mother cells of the zoogonidia."

round the interior of the bladder wall. Fig. 3 is a transverse section through the external tissues of the stem.

Reproduction by zoogonidia, produced in clavate sporangia on the basal leaves. Fig. 4 is a transverse section through a fertile portion of the frond. The sporangia, however, are much more densely crowded together than there represented.

Distribution, everywhere abundant, forming a fringe round the coast; rhizoid fixed below low water-mark.

10. *D'Urvillea utilis.*

Generic description in "Handbook of New Zealand Flora:" "Root scutate. Frond stalked, dark olive-brown or black, flat, expanded, very thick and coriaceous, or honeycombed transversely internally, palmate or pinnate without distinct organs. Fruit diœcious, conceptacles scattered over the whole frond in the cortical stratum, containing either obovoid subsessile spores or branched filaments bearing ovoid antheridia." (*Sp.*) "Frond dark-brown or black, often 30 feet long, forming an immense flabellate palmately-lobed laciniated lamina contracted at the cuneiform base into short stipes as thick as the wrist, segments or thongs often 1 inch thick, honeycombed internally."

The epidermal cells of this plant are much larger than in most brown seaweeds. The central tissue is composed of longitudinal fibres, which occasionally anastomose.

Reproduction: The plant is diœcious. The conceptacles have not a fringe of hairs surrounding the aperture, as in *Fucus platycarpus*, and many other *Fucaceæ*. The reproductive organs may be found almost at any season of the year, but they are best obtained in the winter months. It is stated in Hooker's Handbook (*vide ante*) that the spores (oospheres) are subsessile. This may be the case in young conceptacles; but in the maturer ones the oospheres are developed on branched hairs. Fig. 5 represents one of these branched hairs, bearing several empty and one mature oogonium, with a tripartite oosphere. This is an important exception to the rule that unbranched hairs alone are found in the female conceptacles. Fig. 5, *a*, *b*, *c*, show the method of division of the oosphere.

At low tide, on a warm moist winter's day, many of the fronds of *D'Urvillea*, if examined, are seen to be covered with hundreds of little dark-brown almost black papillæ, consisting solely of oospheres expelled from the conceptacle. The antheridia do not collect outside the conceptacle in such numbers as the oospheres, but they occasionally form whitish dots covering the surface of the frond. The antheridia are developed in the usual way on branched hairs.

Hab. Common about low tide-mark, on exposed rocks.

11. *Notheia anomala.*

Description in Hooker's Handbook (*generic*): "Frond, olive-

green, parasitic, filiform, irregularly branched, proliferous, solid, with distinct stem and branches, but no bladders or leaves. Conceptacles scattered over the whole frond under the surface, containing linear-obovate spores, and simple paranemata." (*Specific*:) "Fronds 3–8 inches long, growing from the conceptacles of *Hormosira*, excessively branched, bushy, cylindric; branchlets narrow, spindle-shaped, axis of solid interwoven filaments, periphery of radiating coloured filaments."

This is undoubtedly a true parasite, as it is never found elsewhere than on *Hormosira banksii.* It generally grows out of one of the conceptacles of its host, but occasionally out of the solid portion of the stem, when it never penetrates deeper than the cortical tissue. True parasitism is very rare among the *Fucoideæ.* One or two cases in the *Phæosporeæ* are mentioned by Decaisne and Le Maout. This is the only one with which I am acquainted amongst the *Fucaceæ.*

Reproduction: The plant is diœcious. I have not seen the male conceptacles; and here it may be noticed that, in all the New Zealand *Fucaceæ*, female specimens are very much more plentiful than the male. The female conceptacle contains unbranched hairs; but there are no long hairs surrounding the aperture of the conceptacle. The oogonia are developed in the ordinary way; but the number of oospheres in each oogonium appears to vary from about 7 to 11; but, as I have had no opportunity of examining fresh specimens of this plant, I am not quite sure about this point. Fig. 6 shows several oogonia.

Hab. In tidal pools, on *Hormosira*; not uncommon, to some extent sporadic.

12. *Hormosira banksii.*

This has been fully described by Mr. Mollet. ("Trans. N.Z. Inst.," 1880, Art. xxxix.)

13. *Splachnidium rugosum.*

Description in Hooker's Handbook (*Generic*:) "Root, a disk. Frond olive-green, cylindric, proliferously branched; branches saccate, full of mucilage and branched filaments; walls thin, membranous. Fruit diœcious. Conceptacles scattered over the whole surface of the frond, attached to the inner surface of its walls, spores linear-oblong, subsessile, paranemata simple." (*Specific*:) "Fronds, 4–8 inches high. Main axis stout, cylindric or club-shaped; $\frac{3}{4}$ inch in diameter; branches sac-like, truncate, 1–2 inches long, surface covered with mamillæ, each furnished with a pore that opens into the spore cavity beneath."

The stem consists of an epidermal tissue of small coloured cells surrounding a mass of mucilage, into which protrude a number of long branched hairs. The top of the growing stem is covered with a slight down, composed of very peculiarly-shaped colourless hairs, made up of a number of cells which are

converse on one side and nearly straight on the other. These cells are sometimes filled with granular matter, which may be forced out by a slight pressure. As the antheridia of the plant have never been observed, it is just possible that these hairs may be antheridial in function.

Reproduction: Plant diœcious. The conceptacle is surmounted by a ring of hairs, and in its interior contains a number of unbranched hairs. The oogonia are obscurely pedicelled, and developed on the cells lining the wall of the cavity. Each oogonium gives rise to a large number of oospheres, thus differing from all other *Fucaceæ* that have hitherto been described. Each oosphere is very small, compared with the oospheres of any of the other *Fucaceæ*. Fig. 7 shows several oogonia.

Hab. An annual, common on tidal rocks.

14. *Cystophora.*

I have no remarks to offer upon this genus.

19. *Carpophyllum maschalocarpum.*

In this plant I have noticed antheridia developed from the surface cells of the conceptacles. Mr. F. O. Bower has noted the same in another genus of *Fucaceæ.*

20. *Marginaria boryana; M. urvilleana.*

Hooker's description is (*Generic*): "Frond olive-green, unilaterally, flabellately pinnate. Leaves, bladders, and receptacles distinct. Leaves sub-confluent with the stem, dichotomously semi-flabellate, vertical. Bladders in series, on the upper margins of the leaves. Receptacles in series with the bladders, unilateral, sub-simple, terete or compressed, containing spherical conceptacles with obovoid spores." (*Sp. boryana:*) "Frond many feet long, naked below; pinnæ linear, very long, $\frac{1}{6}-\frac{1}{4}$ inch broad, ribless with hooked serratures. Bladders elliptic-obovoid, as large as a hazel nut, sub-apiculate. Receptacles cylindric, 1 inch long, acuminate, simple or sparingly spinous. (*Sp. urvilleana:*) A smaller plant than *boryana*, but hardly distinct specifically; the pinnæ are a foot long, gradually dilated, simple or flabellately branched on one side. Bladders smaller, sub-spherical, not apiculate."

I have only seen a few specimens of this genus; but since the two species as figured by Montaigne in the "Voy. au Pole Sud" are evidently male and female plants of a single species, there is probably only one species, subject to a few slight variations.

The stem consists of three tissues, but presents no peculiarities.

Reproduction: Plant diœcious. I have only seen female conceptacles, which are of the ordinary typical form. It is

worthy of notice, however, that the development of the conceptacle in this plant might easily be worked out. A single plant furnishes receptacles with conceptacles at all stages of growth. The oogonium originates as a papillose swelling on one of the parietal cells of the conceptacle, is segmented off, and gradually developes into the mature form. The hairs are developed long before there is any sign of the oogonia, and the conceptacles themselves commence as an invagination of the cortical tissue. Fig. 8 shows a transverse section through a young conceptacle.

Hab. Rare, only met with in fragments cast up upon the shore; probably deep sea.

22. *Sargassum.* I have no remarks to offer upon this genus.

EXPLANATION OF PLATE X.

Fig. 1. Transverse section through bladder-wall of *Adenocystis lessonii*, showing reproductive organs, and hairs on the surface of the frond. (× 140.)

2. Section through conceptacle of *Adenocystis lessonii; a.* and *b.*, cells containing zoogonidia (?) (× 140.)

3. Transverse section through external tissues of stem of *Macrocystis dubenii; a.*, *b.*, *c.*, secretion canals (× 200.)

4. Transverse section through fertile portion of the frond of the same. (× 250.)

5. Branched hairs of *D'Urvillea*, bearing oogonia. (× 140.)

6. Section through portion of conceptacle of *Notheia anomala.*

7. Section through portion of conceptacle of *Splachnidium rugosum.*

8. Section of conceptacle of *Marginaria urvilleana*, showing young conceptacles. (× 45.)

Art. L.—*On the Growth of Transplanted Trees.*

By J. Baber, C.E.

[*Read before the Auckland Institute, 29th June, 1885.*]

In Vol. V. of "Proceedings of New Zealand Institute," fol. 451, will be found a table of the growth of Native trees during 20 years. A continuation of this record may probably be of use at some future time to those engaged in forestry.

The table (1885) attached refers to the same native trees which were the subject of the table of 1872, leaving out those which were merely ornamental. Measurements have been confined to puriri, pohutukawa, titoki, tanekaha, and warengapiro. The sizes of some other trees are added, with their age and the name of planter; many interesting trees at Bird Grove, Epsom, and in St. George's Bay, in plantations made in the early times, have been omitted, as evidence of date cannot be obtained.

As regards kauri, it is to be regretted that the information is scanty, occasioned by the paucity of transplanted trees. Success in raising and planting kauri is difficult.

Some years ago, Dr. Carl Fischer raised kauri seedlings in a very clever way. Bamboo canes from fruit cases were cut in lengths of 5 or 6 inches, placed upright in a boarded case, and filled with earth. The seed sown in them germinated well. There was no difficulty in transplanting, as bamboo and seedling could be put into the ground together. What became of these seedlings I never learnt. The trees in the Government Domain, planted by Mr. Chalmers, domain-keeper, show by their growth that the kauri may be classed amongst profitable trees. Puriri comes next; the demand for this timber is every year increasing, also its value. Comparison between the tables of 1872 and 1885 shows that, although the trees increased slowly in height after 20 years, the succeeding 13 years have added a good deal to their bulk. The value given is estimated at the present price of fencing-posts and house-blocks.

Puriri when young is subject to be killed by frost. It thrives best on hill sides, and the more surrounded by other trees the better. When planted the stem should be cut off 6 inches above the ground; two or three shoots will result, and grow straight up. When fit for poles one or more can be cut, leaving the best for timber. I have examined a great many transplanted puriris and have not found any appearance of makaroa, the worm which bores the tree in its native forest.

I place pohutukawa next in value. No tree is easier raised; hundreds of plants can be obtained from sandstone cliffs, and nine out of ten will grow. Its rate of growth is rather slower than that of puriri, as also its rate of bulk increase. When thoroughly dried it is a durable wood, and in withstanding concussion I think it is superior either to puriri or oak.

Totara is now being taken care of by settlers, as it comes up in many places spontaneously. My record goes back only 20 years, too short a period to form an opinion.

Tanekaha, in many places, is being ruthlessly destroyed for the sake of its bark. For this reason it may be a valuable tree.

Titoki will serve to fill up a plantation; its slow growth will perhaps be compensated by its usefulness in the manufacture of tool-handles, etc. Warengapiro, a cabinetmaker's scented wood, will serve also to fill up. Its growth is very slow; its foliage never yields to the strongest gale. The demand for this wood will increase.

Of matai, towhai, and mairi, particulars are not given.

Of our English trees, oak claims precedence. The oaks in the Government House grounds are the oldest in the Provincial District. The acorns were sent from Sydney, and sown by Mr. Cleghorn, Superintendent of Public Works, in the Government Gardens in 1841 or 1842. The seedlings were planted out in 1844 or 1845, so that these trees are 40 years old. Beautiful as they are, these trees have been neglected for timber purposes;

most of them have trunks not exceeding 7 feet in length, fit only for coopers' staves or firewood. An observer will, however, notice that where the trees were thickly planted, there the butts are longer, and give hope of timber.

Excepting a few easily found, the oaks in the Domain were planted by Mr. Chalmers, domain-keeper, 22 years ago. These 22-year-old trees are equal in height to those in the Government House grounds of 40 years, and have barrels varying from 18 to 25 feet in length; and if attended to, which, I regret to say, is not the case, these trees promise valuable timber. A few years since the Press threw a deal of small ridicule on an old colonist, then a member of the Domain Board, and invented the term "Mitfordise." Time, however, proves that Mr. Mitford was right, and planters will do well to follow his system of trimming off lower branches, so as to produce straight trunks. The best mode of raising oaks is to sow acorns five or six in a place, thin out, and leave one to grow.

The elm flourishes in gullies or low sheltered lands. It is a greedy feeder, and (as will be seen in the table) attains a height of 50 feet in 33 years. When more extensively grown, it will supply a substitute for puriri for railway sleepers. Good examples of wych elms can be seen at Mr. Westwood's, Remuera, planted for shelter and ornament. Their timber capability has been neglected.

Of pines, I have selected two only, the Maritina and Stone pine, which yield good timber; that of the Insignis, so much planted for its beauty and quick growth, is useless, save for firewood. These, sparingly mixed, should form part of every plantation. Some beautiful Stone pines, well trimmed and attended, will be found at Mr. Dilworth's, Remuera, but I am not able to give their age.

The table of 1885 includes two kinds of fruit-bearing yet forest trees, well deserving attention, the walnut and the olive.

The oldest walnut tree in or near Auckland is at Mr. T. Osborne's, Manukau Road, Newmarket. It came from Hobarton in 1842, was planted by the Rev. Walter Laury's tenant, and has been cared for by Mr. Osborne for the last 38 or 39 years. From this tree, and from five others raised from its nuts, Mr. Osborne derives a revenue of £20 a year, £3 6s. 8d. a tree; the estimated value of the tree will be £5. The walnut bears fruit eight years after sowing the nut. If proper care be taken, its butt will rise to 12 feet, a handsome tree, producing a yearly crop, and its timber valuable in the market of the world. The walnut will not flourish on retentive soils, but grows freely on volcanic land, and probably on stony land.

The Olive. The oldest examples of this tree are to be found at Brookside, Parnell, planted by the late Colonel Matson about the year 1848. Growing on sloping ground on a clay soil, these

trees have attained a height of 20 feet, and bear a crop, which is every year consumed by imported birds. These trees will be of value to the owner, as they will afford cuttings and grafts of *O. olivo-vero*, whenever proprietors of land near the sea coast have the good sense to plant this valuable tree. I think it was in 1883 that the Government imported a number of olive eyes and grafts, not knowing that the tree was flourishing here.

This paper refers only to the trees of the North part of this Island. As regards the quantity of timber remaining in the two Islands, it is probable that the next generation will not feel much want of supply; but, with demand and consumption increasing every year, it is plain that 30 or 40 years hence timber will be of great value.

"Let posterity take care of itself" is an adage often used, but it must not be the creed of him who plants forest trees.

TABLE of the RATE of GROWTH of TRANSPLANTED TREES.

NAME OF TREE.	Height in feet.	Circumference 2 feet above the ground.	Age.	Situation.	Value.	Planter.
		ft. in.	Years.		£ s. d.	
Puriri	28	4 4	38	Remuera ..	0 0 0	J. B.
Pohutukawa ..	22	2 0	33	" ..	0 2 6	
Titoki	18	1 0	33	" ..	..	J. B.
Totara	18	1 6	20	" ..	0 1 6	J. B.
Warengapiro ..	11	...	33	" ..	..	J. B.
Kauri	20	1 8	16	Domain ..	..	Chalmers.
Oak	32	3 0	40	Gov. House Grounds	0 3 0	Cleghorn.
Do.	32	2 0	22	Domain ..	0 1 6	Chalmers.
Elm	50	3 9	33	Remuera ..	0 3 0	J. B.
Stone pine ..	41	6 0	35	Epsom ..	..	Capt. Powditch.
Maritina pine	32	3 6	25	Remuera ..	..	J. B.
Walnut	20	5 0	43	Epsom ..	5 0 0	Rev. W. Laury's tenant.
Do.	19	5 0	30	" ..	5 0 0	J. Osborne.
Olive	20	..	36	Parnell ..	..	Col. Matson.

ESTIMATED PRODUCE of PLANTATIONS at end of FIFTY YEARS, planted with 1,000 Trees of 10 different sorts, per acre:—

			£ s. d.
First thinning	10 years	800 ..	..
Second "	20 "	300 @ 1/6 ..	22 10 0
Third "	30 "	300 @ 2/6 ..	37 10 0
Leaving at	50 "	100, worth 10/	50 0 0
			£110 0 0

ART. LI.—*Description of three New Species of* Coprosma.

By T. F. CHEESEMAN, F.L.S.

[*Read before the Auckland Institute, 30th November*, 1885.]

1. *Coprosma tenuifolia*, n. sp.

A RATHER slender, sparingly branched shrub or small tree, 8–15 feet high, glabrous, with the exception of a line of hairs on the midrib and petiole; branches slender, terete, bark pale. Leaves membranous, $1\frac{1}{2}$–5 inches long, $\frac{1}{2}$–$1\frac{1}{2}$ inch broad, varying from ovate or oblong-ovate to oblong-lanceolate or elliptic-lanceolate, acute or acuminate, narrowed into rather long and slender petioles, $\frac{1}{4}$ – $\frac{3}{4}$ inch long, dull brownish-green above, paler below; veins conspicuous on both surfaces, very finely reticulated. Stipules rather large, triangular, connate at the base, thin, often ciliate at the margins or apex when young. Flowers not seen. Fruit in dense fascicles of 3 to 8 on short lateral branchlets, $\frac{1}{4}$ – $\frac{1}{3}$ inch long, ovoid or oblong.

Hab. Ruahine Mountains; *Colenso* ("Handbook," p. 114). Pirongia Mountain; Mount Karioi; abundant on the Mount Egmont Ranges; *T.F.C.* I have also seen specimens collected by Mr. Kirk between Upper Wanganui and the Waikato, so that probably it has a wide distribution in the interior of the North Island.

I have been acquainted with this species for many years, but have delayed describing it, in the hope of obtaining flowering specimens. It was first gathered by Mr. Colenso on the Ruahine Mountains, and is the plant alluded to in the Handbook in a note to the description of *C. acutifolia.* I have never seen *C. acutifolia*, but Mr. N. E. Brown, of the Kew Herbarium, who has done me the favour of comparing the type specimens of that species with my plant, informs me that the two are certainly distinct; and in this opinion Sir Joseph Hooker also concurs.

The dull-green membranous foliage of *C. tenuifolia* approaches that of *C. grandifolia*, and the habit is also not much dissimilar. The fruit, however, proves that the inflorescence is totally different. From *C. lucida*, *C. robusta*, etc., it is at once separated by the membranous leaves.

2. *Coprosma areolata*, n. sp.

An erect, closely branched shrub or small tree, 6–15 feet high, or even more. Branches slender, often fastigiate, bark pale-greyish-green or brown; ultimate pubescent or almost villous, with soft greyish hairs. Leaves in opposite pairs, $\frac{1}{3}$–$\frac{2}{3}$ inch long, orbicular-spathulate, ovate-spathulate, or elliptic-spathulate, usually acute or apiculate, but sometimes obtuse, rather thin and membranous, flat, glabrous or nearly so above, usually

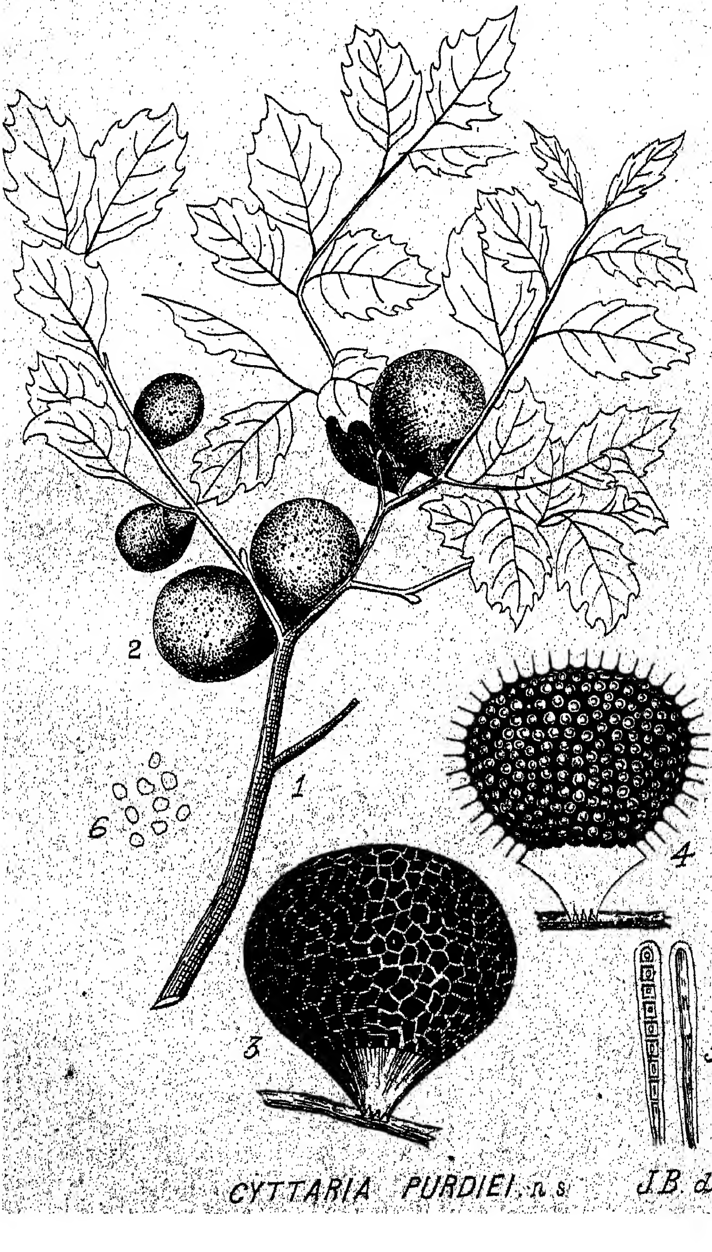
pubescent on the veins below, suddenly narrowed into short hairy petioles; veins reticulated in large areoles. Stipules triangular, pubescent. Flowers axillary, solitary or more usually in few flowered fascicles. *Males:* usually two to four together, small, $\frac{1}{8}-\frac{1}{6}$ inch long. True calyx wanting, but its place is supplied by one or two involucels composed of a pair of depauperated leaves and their stipules, and which closely invest the base of the corolla. Corolla broadly campanulate, divided about half-way down into four or five lobes. Stamens 4–5; anthers large, pendulous. *Females:* solitary or two together, rarely more, $\frac{1}{10}-\frac{1}{8}$ inch long. Calyx limb minute, truncate or very obscurely 4-lobed, closely invested by an involucel similar to that of the male flower. Corolla narrow and tubular at the base, divided about two-thirds of the way down into three or four divisions, lobes often spreading. Drupe small, oblong or obovoid, $\frac{1}{8}$ inch long.

Hab. North Island: common in Auckland province, and probably in most lowland districts. South Island: Nelson, *T.F.C.*; Otago, *D. Petrie.*

A very distinct species, quite different in habit to any of its allies. It forms a compact densely-branched shrub or small tree, usually narrow for its height, and often quite fastigiate. The slender, soft and pubescent branchlets, pale bark and foliage, and the reticulated veins of the leaves, are prominent characters. It is a familiar plant to New Zealand botanists, but has not been previously described. In the "Handbook," as Mr. N. E. Brown informs me, it was confused with *C. rotundifolia.* But that species has wide-spreading branches, larger leaves, more numerous flowers, and a smaller globose or didymous drupe. It is much nearer to *C. tenuicaulis*, but that also differs in its more spreading habit, dark coloured bark, more glabrous leaves and branchlets, smaller, rounder, more coriaceous leaves, and in the globose drupe.

3. *Coprosma petriei*, n. sp.

A small alpine species, with prostrate and creeping stems. Branches long or short, 6–18 inches, usually densely matted, creeping and rooting, glabrous or puberulous. Leaves close set or distant, erecto-patent, coriaceous, $\frac{1}{10}-\frac{1}{4}$ inch long, linear-oblong or linear-obovate, acute or obtuse, gradually narrowed into very short broad petioles or sessile, veinless, glabrous or margins, or both surfaces with short white hairs. Stipules rather long, puberulous and ciliate. Flowers solitary, terminating short erect branchlets. *Males:* $\frac{1}{8}-\frac{3}{10}$ inch long. True calyx wanting, but in its place a series of from 1–3 involucels composed of depauperated leaves and their stipules. Carolla tubular at the base, above broad and campanulate, 4-lobed. Filaments very long. *Females:* Minute, hardly



CYTTARIA PURDIEI. n. s. J.B. del.

$\frac{1}{10}$ inch long, invested at the base with involucels similar to those of the males. Calyx limb irregularly 4–5 toothed. Corolla short, broadly tubular, 4-lobed to below the middle. Styles, 2. Drupe globose, $\frac{1}{6}$ inch diameter, blueish.

Hab. South Island, mountains near Lake Tekapo, Canterbury, altitude 4,000 feet; *T.F.C.* Uplands in the interior of Otago, common; *D. Petrie!*

Mr. Petrie and myself had placed this, with some doubt, under *C. repens*. But Sir Joseph Hooker and Mr. N. E. Brown agree in considering it quite distinct from both *C. repens* and *C. pumila*. The infundibuliform corolla of the male flowers is certainly very distinct from the curved tubular one of *C. repens*.

ART. LII.—*On* Cyttaria Purdiei, *Buch.*

By JOHN BUCHANAN, F.L.S.

[*Read before the Wellington Philosophical Society, 24th February,* 1886.]

PLATE XI.

THE present interesting ephiphytic fungus, although probably abundant in New Zealand, has not hitherto been noticed as occurring there in any scientific work. The genus *Cyttaria*, to which it belongs, is supposed to be limited in distribution to South America and Tasmania, where two species are known and used as food. They are always found epiphytic on species of *Fagus* or beech, and will probably be found wherever this family is abundant.

The internal cavity of this fungus has always been found empty; yet it is probable that in the earlier stages of the plant it may be filled with a gelatinous fluid, which is afterwards absorbed or dried up. This can only be proved by an examination of numerous specimens in different stages of growth.

REFERENCE TO PLATE.

Fig. 1. Branch of *Fagus fusca* with plants of *Cyttaria purdiei* adhering.
2. Young plants of *Cyttaria purdiei*, with the spore cups or cells still covered by a thin membrane.
3. Plant with the spore cups or cells divested of their membranous covering and empty.
4. Section of plant, showing the empty cells with rounded bottoms, and the interior of the fungus empty.
5. Asci with sporidia.
6. Spores.

Art. LIII.—*Additional Contributions to the Flora of the Nelson Provincial District.*

By T. Kirk, F.L.S.

[*Read before the Wellington Philosophical Society, 24th February*, 1886.]

In the fourteenth volume of the Transactions, Mr. Cheeseman has given a valuable catalogue of plants observed by him in the Provincial District of Nelson. I now venture to supplement his list with an enumeration of the species collected during my hasty visits to different parts of the district, and which do not appear to have come under his notice. I have added a few species, of which specimens have been given to me by Mr. P. Lawson, who resided in Nelson for two years; the Rev. F. H. Spencer, now of Reefton; and Mr. D. Grant, of Nelson: the authority being stated in each case. A few localities are stated for such plants as *Mimulus repens*, *Epacris pauciflora*, *Lomaria fraseri*, etc., etc., inserted by Mr. Cheeseman on the authority of the "Handbook of the New Zealand Flora," but not actually observed by him.

Although the plants now catalogued form a material addition to the previous record, the chief interest lies in the importance of certain species from the phyti-geographical point of view: *e.g.*, *Actinotus bellidioides*, *Liparophyllum gunnii*, *Metrosideros robusta*, *M. tomentosa*, *Schœnus nitens*, *Cladium teretifolium*, *Euphrasia disperma*, *Trichomanes humile*, etc., etc.; but our knowlege of the Flora of the district must be made more complete before we are able to appreciate their correct significance.

Ranunculaceæ.

Clematis afoliata, J. Buch. Hanmer Plains; Wai-au-ua River.

Ranunculus subscaposus, Hook. f. Two forms of this plant are not uncommon by the Stanley River, and in other parts of the Amuri:—
- α. Erect, leaves on long petioles, excessively silky, peduncles stout, much shorter than the leaves.
- β. Much branched, sub-fluitant, hairy or almost glabrous; petioles short.

Cruciferæ.

Lepidium oleraceum, Forst. The Arrow Rock, *H. B. Kirk!*

Pittosporeæ.

Pittosporum patulum, Hook. f. Spencer Mountains.

Hypericineæ.

Hypericum gramineum, Forst. Nelson.

MALVACEÆ.

Hoheria populnea, A. Cunn.; β. *lanceolata*. Takaka Valley, etc.
Hibiscus trionium, L. South Wanganui, Lyell ("Handbook"); near Collingwood.

TILIACEÆ.

Aristotelia colensoi, Hook. f. Rotoiti; Lyell, etc.
Elæocarpus dentatus, Vahl. Near Westport; Takaka Valley, etc., etc.

ANACARDIACEÆ.

Corynocarpus lævigata, Forst. A single specimen grows near Karamea, *J. H. Jennings;* also reported to occur in the vicinity of Collingwood.

CORIARIEÆ.

Coriaria angustissima, Hook. f. Spencer Mountains.

LEGUMINOSÆ.

Carmichælia grandiflora, Hook. f. Lyell, and other places in the Valley of the Buller.
Swainsonia novæ-zealandiæ, Hook. f. Above Fowler's Pass; Spencer Mountains.

ROSACEÆ.

Geum uniflorum, J. Buch. Spencer Mountains.

HALORAGEÆ.

Myriophyllum pedunculatum, Hook. f. Near Cape Farewell.
Gunnera densiflora, Hook f. Descends to the sea level at Cape Farewell Spit.
,, *prorepens*, Hook. f. Mokihinui.

MRYTACEÆ.

Metrosideros parkinsonii, J. Buch. Aorere Valley.
,, *robusta*, A. Cunn. From Greymouth northwards to Cape Farewell, common; Collingwood; Aorere Valley; Takaka and Riwaka Valleys, etc.
,, *tomentosa*, A. Cunn.

Mr. Macallister, of the Telegraph Department, informed me that this species was plentiful on the cliffs between Riwaka and Waitapu, where it occurred in sufficient quantity to furnish the framework of a small vessel built there a few years ago. I was also assured by a surveyor that one or two trees were still standing on a point between Takaka mud-flats and Collingwood. At a point nearer Collingwood I found several stunted plants from 1 to 2 feet high on the face of a cliff; but as the leaves had not assumed the tomentose condition characteristic of the mature state of this species, I hesitate to pronounce them identical, although their leaves are broader than those of *M. robusta*, the only species which could be mistaken for it.

Mr. Macallister was so well acquainted with the pohutukawa in Auckland, that it is not probable he is mistaken in the identification. At the same time, its occurrence in the South Island is so unexpected that it is most desirable to obtain specimens of the Waitapu plant in the mature state.

Myrtus bullata, Banks and Sol. In one place near the Dun Mountain track; also by the road to the copper mine; *Mr. Buckeridge.*

I did not see this plant in the Nelson district, but Mr. Buckeridge, of the Survey Department, who was my travelling companion through the Rai Valley, where it is plentiful, informed me that he had observed it in the localities mentioned above. It is common about Picton, and in other localities in Marlborough.

M. ralphii, *M. obcordata*, and *M. pedunculata*, were observed by Dr. Boor and myself growing in close proximity in one of the lateral valleys of the Maitai, in 1878, but we searched in vain for *M. bullata.*

ONAGRARIEÆ.

Epilobium confertifolium, Hook. f.; *β. tenuipes.* Spenser Mountains.

,, *alsinoides*, A. Cunn. Abundant in many parts of the district.

UMBELLIFERÆ.

Hydrocotyle americana, Arn. Mokihinui, etc.

,, *asiatica*, L. Aorere Valley, etc.

,, *muscosa*, Br. Lake Guyon.

,, *pterocarpa*, F. Müeller. Mokihinui.

Pozoa haastii. Hook. f. Spenser Mountains.

Ligusticum haastii, F. Müell. Spenser Mountains.

Angelica decipiens, Hook. f. Mount Captain Range, Amuri.

Actinotus bellidioides, Beush. Var. *novæ-zelandiæ.* Mount Rochfort, *Rev. F. D. Spenser.*

RUBIACEÆ.

Coprosma pumila, Hook. f. Between Fowler's Pass and Lake Guyon, etc., etc.

Mr. Cheeseman states that he can find no distinguishing characters between this species and *C. repens*, and believes both to be forms of the same plant.

I am unable to accept this view, on account of the wide difference between the fruits of the two species, independently of other characters. The fruit of *C. pumila* is spherical, slightly depressed, crimson, small; while that of *C. repens* is ovoid, purple, translucent, the largest of the genus. At elevations of 3,000 feet and upwards, *C. pumila* becomes nearly herbaceous; but *C. repens* invariably retains its ligneous habit, even at the extreme altitude of 4,500 feet.

In "Handbook of the N.Z. Flora" the fruit of *C. pumila* is described as that of *C. repens* also.

Compositæ.

Cotula australis, Hook. f. Wakapuaka, etc., etc.
Senecio sciadophilus, Raoul. Nelson; *Rev. F. H. Spencer!*

Stylidiceæ.

Forstera bidwillii, Hook. f. Rotoiti.
Phyllachne clavigera, Beush. and Hook. f. Spenser Mountains.

Ericeæ.

Epacris pauciflora, A. Rich. Aorere Valley; Takaka Valley; common about Waimangaroa, Westport, etc.
Dracophyllum latifolium, A. Cunn. Riwaka Valley; Takaka Valley; Aorere Valley; Waimangaroa.

Jasmineæ.

Olea lanceolata, Hook. f. Wairoa.

Gentianeæ.

Liparophyllum gunnii, Hook. f. Mount Rochfort; *Dr. Gaze.*

Convolvulaceæ.

Cuscuta densiflora, Hook. f. Nelson; *P. Lawson.*
,, sp. nov. Ahaura Plains.

Scrophularieæ.

Mimulus repens, Br. Muddy places in Nelson Harbour; occurring in great abundance during certain seasons, but often extremely rare.
Gratiola nana, Beush. Rotoiti, 1875.
Veronica macroura, Hook. f. Tarndale; "Handbook N.Z. Fl."
,, *diosmæfolia*, R. Cunn. A plant, of which I found specimens in the Maitai Valley, but in an imperfect condition, is doubtfully referred to this for the present.
,, *canterburiense*, J. B. Armstrong. Rotoiti, etc.
Pygmæa ciliolata, Hook. f. Amuri.
Euphrasia cuneata, Forst. Aorere River.
,, *disperma*, Hook. f. Mount Rochfort, *Rev. F. H. Spencer;* Ahaura Plains, *T.K.*

Lentibularieæ.

Utricularia monanthos, Hook. f. Lake Guyon.

Chenopodieæ.

Rhagodia nutans, Br. The Brothers; near Westport, *Dr. Gaze.*
Chenopodium urbicum, L. Amuri; Hanmer Plains.
,, *pusillum*, Hook. f. Nelson, *Professor F. W. Hutton!*
Atriplex cinerea, Poir. Nelson, *P. Lawson!*

Proteaceæ.

Knightia excelsa, Br. Croixelles Harbour.

THYMELEÆ.

Pimelea traversii, Hook. f. Amuri.
,, *arenaria*, A. Cunn. Cape Farewell.

LORANTHACEÆ.

Loranthus micranthus, Hook. f. Waimangaroa; Mokihinui, etc.

EUPHORBIACEÆ.

Euphorbia glauca, Forst. Cape Farewell, etc.

CUPULIFERÆ.

Fagus blairii, T. Kirk. Valley of the Little Grey River.

CONIFERÆ.

Podocarpus acutifolius, T. Kirk. Hope Valley; Rotoiti, etc.
Dacrydium westlandicum, T. Kirk. Aorere Valley, and other places on the West Coast as far South as Greymouth.

ORCHIDEÆ.

Earina autumnalis, Hook. Lower part of the Valley of the Buller.
Dendrobium cunninghamii, Linde. Aorere Valley; Mokihinui; Westport.
Bolbophyllum exiguum, F. Müell. Collingwood; "Trans. N.Z. Inst.," vol. xvi., p. 397.
Acianthus sinclairii, Hook. f. Nelson, *H. B. Kirk!*
Adenochilus gracilis, Hook. f. Nelson, *P. Lawson*, 1869.
Caladenia minor, Hook. f. Port Hills, Nelson, etc.
Pterostylis micromega, Hook. f. Lake Guyon.
Prasophyllum nudum, Hook. f. Dun Mountain, *H. H. Travers!* in Colonial Museum.
Calochilus paludosus, Br. Collingwood; "Trans. N.Z. Inst.," vol. xvi., p. 397.

NAIADEÆ.

Potamogeton oblongus, Vir. Takaka Valley; Aorere Valley; Mokihinui.
Zostera nana, Rosh. Takaka mud-flats.

LILIACEÆ.

Astelia cunninghamii, Hook. f. On the western side of the district from Collingwood to Charleston, but somewhat local.
,, *grandis*, Hook. f. Lowland swamps on the West Coast.
,, *solandri*, A. Cunn. Not uncommon on the West Coast.
,, *trinervia*, T. Kirk. Between Wakapuaka and the Rai Valley.
Arthropodium cirrhatum, Br. West Wanganui, *Mr. R. Hurst-house*, M.H.R.!

JUNCEÆ.

Juncus brevifolius, T. Kirk. Rotoiti.
,, *involucratus*, T. Kirk, Amuri.

RESTIACEÆ.

Centrolepis monogyna, Beush. Mount Rochfort, *Rev. F. H. Spencer.*

CYPERACEÆ.

Schœnus axillaris, Hook. f. Aorere Valley, etc.
,, *tenax*, Hook. f. Aorere Valley.
,, *tendo*, Hook. f. Aorere Valley.
,, *nitens*, Hook. f. Cape Farewell Spit.
Eleocharis sphacelata, Br. Takaka Valley.
,, *acuta*, Br.; var. *platylepis*. Motueka; Aorere Valley; and other places; common.
,, *gracillima*, Hook. f. Aorere Valley.
Isolepis inundatus, Br. Aorere Valley, etc.
Cladium glomeratum, Br. Takaka Valley; Aorere Valley; West Coast.
,, *teretifolium*, Br. Aorere Valley.
,, *gunnii*, Br. Aorere Valley; West Coast.
Gahnia rigida, T. Kirk. Aorere Valley; Ngakawau.
Oreobolus filiformis, Bergg. Mount Rochfort.
Uncinia ferruginea, Booth. Ngakawau; Mokihinui; Westport.
Carex viridis, Petrie. Valley of the Stanley, Amuri.

GRAMINEÆ.

Stipa micrantha, Car. Upper part of the Takaka Valley, *Rev. F. H. Spencer!*

Apera arundinacea, Hook. f. Nelson.

Sporobolus indicus, R. Br. A few tufts on the Port Hills, Nelson, 1873, *Capt. D. Rough* and *T. Kirk.*

Agrostis pilosa, A. Rich. Abundant in the Amuri.

Phragmites communis, Fries. Valley of the Little Grey, *Dr. von Haast.*

Catabrosa antarctica, Hook. f. Mount Arthur, *J. Buchanan*; "Indigenous Grasses of N.Z."

Poa lindsayi, Hook. f. Amuri.

,, *pusilla*, Bergg. Amuri.

,, "*intermedia*," J. Buch. Rotoiti.

,, *sclerophylla*, Bergg. Mount Captain Range.

,, "*uniflora*," J. Buch. Mount Arthur; "Indigenous Grasses of N.Z."

Bromus arenarius, Lab. Cape Farewell.

FILICES.

Gleichenia circinata, Swartz. Aorere Valley, and West Coast.
,, *cunninghamii*, Heward. Aorere Valley, and West Coast to Greymouth.
Cyathea cunninghamii, Hook. f. Bateman's Gully, *D. Grant!*
Hymenophyllum cheesemanii, Baker. Mokihinui.
Trichomanes elongatum, A. Cunn. Collingwood, *D. Grant!*
,, *humile*, Forst. Happy Valley, Nelson, *D. Grant!*
Lindsaya linearis, Sw. The Port Hills, *D. Grant!* Collingwood.
,, *trichomanoides*, Dryander. Foxhill; Collingwood, *D. Grant!*
Adiantum hispidulum, Swartz. Bishopdale, *D. Grant!*
,, *diaphanum*, Willd. Bateman's Gully, *D. Grant!*
,, *fulvum*, Raoul. Nelson; Mokohinui.
Pellæa falcata, Br. Mr. A. Collins' Bush, near Nelson, *D. Grant!*
Lomaria membranacea, Col. Nelson; Bishopdale, etc., *D. Grant!*
,, *banksii*, Hook. f. West Wanganui, etc., *D. Grant!*
,, *nigra*, Col. Collingwood, *D. Grant!*
,, *fraseri*, A Cunn. West Coast, as far South as Charlestown, but somewhat local.
Doodia media, Br. Port Hills, Nelson.
Polypodium tenellum, Forst. Not unfrequent in Suburban North, Nelson; Poor Man's Valley, etc.; *D. Grant!*
Schizæa fistulosa, Lab. Aorere Valley.

LYCOPODIACEÆ.

Lycopodium laterale, Br. Aorere Valley; plentiful.
Tmesipteris forsteri, Endlicher. On tree ferns, Maitai Valley; very local.

ADDENDA.

The following are stated to have been collected on Mount Franklin, by Mr. Park of the Geological Survey Department, on the authority of Mr. J. Buchanan ("Trans. N.Z. Inst.," vol. xvii., p. 356):—

Ranunculus lyallii, Hook. f.
Cotula pectinata, Hook. f.
Gentiana concinna, Hook. f.*
Veronica linifolia, Hook. f.
"*Mitrasacne cheesemanii*," J. Buch.
Ourisia macrocarpa, Hook. f.
Carex wakatipu, Petrie.

* Hitherto this species has only been recorded from the Auckland and Campbell Islands, and it is to be feared that a clerical error has occurred, Mount Franklin being a most unlikely habitat for a plant that can only exist when growing in peat.

ART. LIV.—*On a new Variety of* Desmid.

By W. M. MASKELL, F.R.M.S.

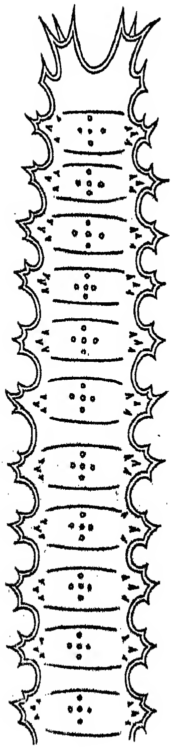
[*Read before the Wellington Philosophical Society, 24th February,* 1886.]

Genus **Triploceras**, Bailey.

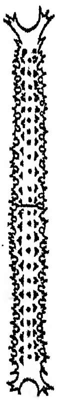
Triploceras tridentatum, Maskell; var. *superbum*, var. nov.

Frond slender, elongated, cylindrical, very slightly depressed at the middle.

Denticulate lateral projections of the segments large, somewhat prominent, tri-dentate, the middle tooth the largest. Edges of frond between the projections slightly curved inwards, so that the segments appear as if with several toothed transverse rings. Denticulations pointing at right angles to segment near the constriction, and slightly forward near the extremities. The small processes at the base of the terminal tridentate prolongations sharply pointed forwards, not tri-apiculate. Terminal processes, 2, sub-rectangular, tri-dentate.



X 400



X 60

Endochrome, not very dark-green.

Length of frond, about 625 μ; breadth near constriction, about 50 μ.

From Wainui-o-mata, near Wellington.

This is a more ornate and elegant plant than *T. tridentatum*, or its other variety, *cylindricum*, on account of the more complex lateral denticulations. In the locality mentioned it seems to be somewhat abundant: it is quite constant in its characters.

IV.—GEOLOGY.

Art LV.—*On the Geology of Scinde Island.*

By Captain F. W. Hutton, F.G.S.

[*Read before the Philosophical Institute of Canterbury, 2nd July*, 1885.]

Plate XIII., fig. 6.

The first notice of the geology of the isolated, rocky bluff called "Scinde Island," on which the Town of Napier is partly built, is a section by Mr. Triphook, published by Dr. von Hochstetter in the "Reise der *Novara*" (Geologishert, Theil I., p. 2), but Dr. von Hochstetter did not himself visit the locality. This section is from Cape Kidnappers to Petane, and shows the Scinde Island rocks as an outlier of the Petane beds, which lie four or five miles to the north. Dr. von Hochstetter called them the "Hawke's Bay Series"—"limestones, sandstones, and clay-marls replete with fossils: *Pecten triphooki*, Zittel; *Venus*, *Mytilus*, *Pectunculus*, *Trochita*," etc., and considered them as belonging to the younger of the two systems into which he divided our tertiary rocks.

In 1871 Dr. Hector reported on the district, and agreed with Mr. Triphook, saying that the Scinde Island beds belonged to the upper part of the formation, and occupied the centre of a syncline from Cape Kidnappers to Pohui, which lies on the road from Napier to Lake Taupo.*

Among the tertiary fossils in the Colonial Museum at Wellington, which I examined in 1872, were some from "Napier and Cape Kidnappers,"† and these I referred to the "Ahuriri Formation" (since called the Ahuriri series of the Pareora system), making them older than the Wanganui Formation, ("Cat. Tert. Moll. and Echin. of N.Z.," p. 8,) which at that time was only known on the west coast of Wellington. There were no fossils from the Petane beds in the Museum, and, consequently, no opinion was expressed as to the age of that series.

* "Reports Geol. Survey," 1870-71, p. 159.

† "Catalogue of the Colonial Museum," 1870, p. 180.—"Limestones and clay-marls exposed in the cliffs around Scinde Island, and along the coast. The same formation is general throughout the east part of Hawke's Bay."

On the 27th November, 1876, Mr. S. Percy Smith read a paper to the Auckland Institute called a "Sketch of the Geology of the Northern Portion of Hawke's Bay," ("Trans. N.Z. Inst.," vol. ix., p. 565,) in which he makes the sandstone of Scinde Island and the Napier limestone to be the same as the Petane beds. He also gives a list of fossils from the different beds.

In March, 1876, Mr. S. H. Cox examined the country,* and stated that the Napier limestone underlaid the Petane beds at Scinde Island, and that it was the equivalent of the Pohui limestone at Te Waka, on the Taupo Road. He says: "At Scinde Island, Napier, where the typical development of these beds [Napier limestone, etc.,] occur, they are forming a low anticline, dipping on the sea-face, S. 10°, but on the harbour side N.W. 25°" (*l.c.*, p. 100). He considered that all the tertiary beds belonged to one series, without any uncomformity between them.

Dr. Hector, in his Progress Report for the same year, says that the fossils from the Petane series "seem to place them in the same horizon as the Upper Wanganui beds" (*l.c.*, p. viii.), but he considered the Napier limestone to be the same as the Petane limestone.

In the early part of 1877, Mr. A. McKay examined the district and reported that certain marls and pumice sands, which underlie the limestone at Puketapu (Petane limestone) form the lowest beds exposed on the south-west side of Scinde Island: that "they dip to the N.E,, bringing the limestones to the sea level at the north end of Shakespeare Road, but are found at a higher level in the Bluff along the sea beach," ("Rep. Geol. Exp.," 1856–7, p. 84,) thus forming a syncline. In his Progress Report for the year, Dr. Hector remarks that "the general results of this examination are that the Scinde Island limestone (=Napier limestone) is shown to be the highest marine bed in the district, being separated from the limestones of the Puketoi Range and Manawatu Gorge by a great series of fossiliferous sands and clays, estimated in the district west of Napier to be not less than 2,000 feet thick." (*l.c.*, p. 11.)

In August, 1878, Mr. A. McKay again visited the district south of Napier, and ascertained that the "pumice sands and lignite series" (*i.e.* the Petane series) rested unconformably on the Te Aute limestone (*i.e.* the Ahuriri series) at Mount Vernon, near Waipukurau ("Rep. Geol. Explorations," 1878–79, p. 72); and Dr. Hector remarks, in his Progress Report, that "as the former series (Petane series) is closed by the Scinde Island beds, the rocks at the town of Napier do not belong to the same horizon as the Te Aute limestone." (*l.c.*, p. 26.)

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* "Rep. Geol. Exp.," 1874-76, p. 96. This report was not published until 1877, after Mr. Percy Smith's paper had been read; so that each is independent of the other.

It thus appears that all the observers, except Mr. Cox, place the Napier or Scinde Island limestone in the upper part of the Wanganui system, which is directly opposed to the conclusion drawn from the published lists of fossils. The stratigraphical and palæontological evidence seemed therefore to clash, and I gladly availed myself of an opportunity that occurred last January of visiting Scinde Island to try to clear up the difficulty. This, with the able assistance of Mr. A. Hamilton, of Petane, and Mr. H. T. Hill, of Napier, I think I have accomplished.

The result of my examination is to show that the northern end of the island is formed by the Petane series. This series rests unconformably on the Scinde Island limestone, which forms, with the underlying sandstone, all the southern part of the island, as shown in the accompanying section. (Pl. XIII., fig. 6.)

Collections of fossils from here, and from Petane, prove the accuracy of Dr. Hector's opinion that the Petane beds are the equivalents of the Wanganui beds. The fossils from the Scinde Island limestone, however, show that it is the equivalent of the Te Aute limestone, which is the same as the Pohue limestone of Te Waka.

AHURIRI SERIES.

This series forms the main part of the island, from the southern end to beyond Curling's Gully on the eastern, and as far as the Taradale Bridge on the western side. It consists of the following rocks, in descending order:—

3. White earthy limestone, with bands of bluish-grey compact limestone with shells.
2. Yellowish sandstone, with irregular layers of compact limestone, passing downwards into—
1. Yellowish sandstone, glauconitic in places. The lowest bed seen.

All three pass gradually into each other.

On the south-east side of the island this series dips about S.E. 5°. To the northward, it gets horizontal, and then dips to the north-west. On the east side, at Curling's Gully, the dip is N.W. 20°; and on the west side, at Taradale Bridge, it is N.N.W. 10°. The limestone is quarried in many places. Fossils are generally in the form of casts, and are most abundant in the upper parts, especially in Curling's Gully and Milton Road. They are not, however, altogether absent in the lower sandstones. I noticed the following:—

1. *Siphonalia mandarina*, Duclos. (?)
*2. *Trochita neozelanica*, Lesson.
3. *Crepidula monoxyla*, Lesson.

* Abundant.

*4. *Crepidula incurva*, Zittel.
5. *Panopæa neozelanica*, Quoy. (?)
6. *Mactra discors*, Gray. (?)
7. *Hemimactra notata*, Hutton. (?)
8. *Hemimactra elongata*, Quoy. (?)
9. *Lutraria solida*, Hutton.
10. *Paphia neozelanica*, Chemnitz.
11. *Venus strutchburyi*, Gray.
12. *Venus sulcata*, Hutton.
13. *Dosinia subrosea*, Gray.
*14. *Cardita australis*, Lamarck.
*15. *Pectunculus laticostatus*, Quoy.
*16. *Mytilus magellanicus*, Lamarck.
17. *Modiola australis*, Gray.
*18. *Pecten triphooki*, Zittel.
19. *Pecten accrementus*, Hutton.
20. *Pecten chathamensis*, Hutton.
21. *Pecten neozelanica*, Gray.
*22. *Pecten burnetti*, Zittel.
*23. *Ostrea nelsoniana*, Zittel.
24. *Waldheimia patagonica*, Sowb.

All these species are found in rocks belonging to the Pareora system in other parts of New Zealand, except *Hemimactra notata* and *Mytilus magellanicus*, and the first of these is doubtfully identified from casts only. The following are characteristic Pareora fossils:—*Crepidula incurva*, *Pecten triphooki*, *Pecten accrementus*, *Pecten chathamensis*, *Pecten burnetti*, and *Waldheimia patagonica*. The last species ranges into the Oamaru system, but the other five are confined to the Pareora system. Of the 24 species enumerated, no less than 15, or 61 per cent., are recent. But this percentage of species is probably too large, as several of the fossils have been doubtfully referred to living species from casts alone, and they are mostly *Lamellibranchiata*, which have a longer specific life than *Gastropoda*. Future research will, no doubt, reduce the proportion of living species.

Petane Series.

This series occupies the north-east corner of the island. The unconformity between it and the underlying Scinde Island limestone is very apparent on the eastern shore, opposite the Spit. The unconformity is not so clear on the western side, owing to the large accumulations of the overlying brick-earth, or loam.

The series consists of the following:—

2. Shelly limestone, formed by comminuted shells, resting on—
1. Soft sandstone of a yellow, grey, or brown colour.

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* Abundant.

The limestone (*b* in the section) occupies very little of the surface, as it is covered over with the brick-earth. It can, however, be seen at the top of the cliffs at the north end of the island, and again a little north of Curling's Gully, where it is separated from the Scinde Island limestone by the sandstone (*c* in the section). This latter forms the base of the cliffs all along the north side, from near the Taradale Bridge to beyond Battery Point. Although I looked carefully, I could find no trace of the pumice beds said by Mr. McKay to underlie it.

The following is a list of the fossils we collected from these rocks :—

1. *Amphibola avellana*, Chemnitz.
2. *Ancillaria australis*, Sowb.
3. *Voluta pacifica*, Lamarck.
4. *Siphonalia mandarina*, Duclos.
5. *Cerithidea bicarinata*, Gray.
6. *Cerithidea tricarinata*, Hutton.
7. *Trochita neozelanica*, Lesson.
8. *Crepidula monoxyla*, Lesson.
9. *Turritella rosea*, Quoy.
10. *Turritella tricincta*, Hutton.
11. *Scalaria zelebori*, Frauenfeld.
12. *Turbo smaragdus*, Martyn.
13. *Rotella neozelanica*, Hombron.
14. *Dentalium nanum*, Hutton.
15. *Corbula erythrodon*, Lamarck.
16. *Hemimactra notata*, Hutton.
17. *Lutraria solida*, Hutton.
18. *Zenatia acinaces*, Quoy.
19. *Paphia neozelanica*, Chemnitz.
20. *Venus stutchburyi*, Gray.
21. *Venus meridionalis*, Sowerby.
22. *Venus sulcata*, Hutton.
23. *Venus mesodesma*, Quoy.
24. *Dosinia grayi*, Zittel.
25. *Tapes intermedia*, Quoy.
26. *Cardium striatulum*, Sowb.
27. *Loripes concinna*, Hutton.
28. *Cardita australis*, Lamarck.
29. *Pectunculus laticostatus*, Quoy.
30. *Pectunculus striatularis*, Lamarck.
31. *Mytilus magellanicus*, Lamarck.
32. *Mytilus latus*, Chemnitz.
33. *Modiola australis*, Gray.
34. *Pinna neozelanica*, Gray.
35. *Lima bullata*, Born.
36. *Pecten neozelanicus*, Gray.
37. *Pecten radiatus*, Hutton.

38. *Pecten semiplicatus*, Hutton.
39. *Pecten convexus*, Quoy.
40. *Pecten laticostatus*, Gray.
41. *Anomia alectus*, Gray.
42. *Ostrea edulis*, Linneus.
43. *Waldheimia ovalis*, Hutton.
44. *Terebratella rubicunda*, Solander.
45. *Rhynchonella nigricans*, Sowb.

Of these, *Dentalium nanum* is at present only known from the Wanganui system; while *Amphibola avellana*, *Cerithidea bicarinata*, *C. tricincta*, *Turbo smaragdus*, *Corbula erythrodon*, *Pectunculus striatularis*, *Pecten radiatus*, and *Mytilus latus* have not yet been found in the Pareora system. Of the 45 species enumerated, 38, or 84 per cent., are recent. A small rolled fragment of *Pecten triphooki* was also found, but it probably came out of the Scinde Island limestone. However, I found a broken and rolled specimen of this species at Moteo, near Puketapu, which possibly had not been derived from any older rocks.

Brick-earth.

This formation forms the top of most of the hills, and lies quite unconformably on both the Ahuriri and the Petane series. It descends to the sea level on the east side of the island, in a valley a little south of Battery Point (*see* section), and also in two or three other places on the west side. It is a reddish-brown sandy clay, or loam, often showing the "capillary structure" of the so-called Loëss of Banks Peninsula; from which, however, it can be distinguished by its darker colour. I saw pumice in it in two places. One on a hill not far from the Hospital. The other in the valley just mentioned, south of Battery Point. In the latter place a considerable layer of pumice sand is seen on the northern slope of the valley, overlain by the brick-earth. In the other locality, small fragments of pumice are scattered through the brick-earth. At Battery Point a thin bed of shingle lies at the base of the brick-earth, but I saw no shingle at the south end of the island.

This loam bed is used for making bricks in Napier. It is also found in many places north of Napier, and is especially conspicuous on the hills near Puketapu.*

At the south-west end of the Bluff, at the sea level, below the limestone quarry worked by the prisoners, is a bed of clay containing fragments of rock, in which Mr. Hamilton informs me he has found moa bones. This clay may be of the same age as the brick-earth, or it may be younger. Probably the latter is the case, but I could not satisfy myself on this point.

* This is probably the "light-grey sandy marls," mentioned by Mr. McKay as seen on the road between Puketapu and Taradale ("Geol. Reports," 1876–77, p. 84); but it does not underlie "the limestone capping the hills to the north," as Mr. McKay appears to think; and it is not marly.

ART. LVI.—*New Species of Tertiary Shells.*

By Captain F. W. HUTTON, F.G.S.

[*Read before the Philosophical Institute of Canterbury, 2nd July,* 1885.]

IN this paper I give descriptions of a few more fossil shells. The list of New Zealand tertiary mollusca now numbers about 460 species, of which about 250 still remain unfigured.

CYLICHNA (VOLVULA) REFLEXA, n. s.

Shell sub-cylindrical, mucronate posteriorly, smooth, a few distant spiral lines at the anterior end. Aperture narrow, rather effuse anteriorly, the inner lip being strongly reflected over the columella. Length, 0·12 inch.

Locality. White Rock River, South Canterbury.

MUREX ESPINOSUS, n. s.

Shell fusiform, with a moderate canal and no spines. Whorls $5\frac{1}{2}-6\frac{1}{2}$, the first embryonic, the others spirally and longitudinally ribbed. Longitudinal ribs rounded, distant, 8 or 9 on a whorl; spiral ribs strong, scaly, close, about 10 on the penultimate, and 25–30 on the body whorl; those just below the suture smaller than the others. Aperture oval, rather suddenly contracted into the moderate and slightly bent canal, which is more or less closed. Length, 1·2 inch; breadth, 0·6 inch.

Locality. Petane.

Distinguished from *M. octagonus* by the complete absence of spines.

NASSA SOCIALIS.

Nassa compta, Hutton, "Trans. N.Z. Inst," vol. ix., p. 296, pl. xvi., fig. 9; not of Adams.

COLUMBELLA ANGUSTATA, n. s.

Shell elongato-fusiform, spirally grooved, the spire longer than the aperture. Whorls 6–7, flattened, the suture distinct; spiral grooves narrow and rather distant, 7 on the penultimate, and about 15 on the body whorl. Aperture elongately-oval, not contracted in the middle; the outer lip thin (?) (broken). Length, 0·48; breadth, 0·15; aperture, 0·2 inch.

Locality. Petane. A single specimen.

PLEUROTOMA PLICATELLA, n. s.

Shell fusiform, the spire turreted, but not much larger than the body whorl. Whorls $8\frac{1}{2}$, the first $1\frac{1}{2}$ embryonic, the others spirally striated. Spire whorls longitudinally ribbed below the sinus area, and slightly so at the suture; about 15–17 in a whorl. The spiral striations extend over the whole surface, but are reduced to two in the sinus area. On the body whorl the

longitudinal ribs are obsolete, except at the suture, where they are tolerably strong; the spiral ribs are strong and irregular, the intermediate grooves sometimes as broad as the ribs, sometimes narrower. Aperture oval, with a very short anterior canal; the sinus deep, situated some distance below the suture. Length, 0·92; breadth, 0·38; aperture, 0·42 inch.

Locality. Wanganui.

DRILLIA ÆQUISTRIATA, n. s.

Whorls 8; the first 1½ embryonic, smooth, and expanded into a papilla, the others spirally striated and longitudinally ribbed in the centre, except the body whorl, on which the longitudinal ribs become gradually obsolete. There are 15 oblique longitudinal ribs on a whorl, crossed by numerous low and subequal spiral ribs. Sinus area concave and covering the suture, but spirally ribbed like the rest. Aperture oval; canal very short; posterior sinus small but distinct; the inner lip with a large posterior callus. Length, 0·75; breadth, 0·2; aperture, 0.34 inch.

Locality. Petane.

The spiral sculpture is much stronger than in *D. alabaster.*

NATICA DARWINII.

Natica solida, Sowb., in Darwin's "Geol. Obs. on South America," p. 255, pl. iii., f. 40-41 (1846); Zittel "Reise der *Novara*," Palæ, p. 42, taf. xv., f. 6; not *N. solida*, Blainville, Malac., pl. 36, f. 8 (1825).

As Sowerby's name must sink into a synonym, I have called this species after the illustrious naturalist who collected it.

NATICA (NEVERITA) GIBBOSA.

Natica solida, "Cat. Tertiary Moll. of N.Z.," in part.

Shell large, solid, smooth, globose, the spire almost buried; the body whorl gibbous posteriorly. Aperture semicircular, the columellar callus very large, filling the posterior portion of the aperture, and eventually covering the whole umbilical region. Length, 2· inch; breath, 2· inch.

Locality. Trelissic Basin; White Rock River, and many other places.

Distinguished from *N. darwinii* by the short spire, the gibbous body whorl, and the covered umbilicus.

CERITHIUM NODOSUM.

Cerithium nodulosum, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 12; not of Brug.

BITTIUM CINCTUM, n. s.

Distinguished from *B. terebelloides* by its larger size, by the spire whorls having four, instead of three, spiral ribs, and by the body whorl having 6–8 spiral ribs.

Locality. Wanganui and Petane.

I have revived for this species the name which I formerly bestowed on *B. terebelloides*, Martens.

STRUTHIOLARIA CALCAR.

Struthiolaria cincta, var. C., Hutton, "Cat. Tertiary Moll. of N.Z.," p. 11.

This species has been found by Dr. von Haast at Tengawai Cliffs, South Canterbury; and, as it keeps its characteristic claw with great constancy, I think it deserves a specific name.

STRUTHIOLARIA SPINOSA.

Struthiolaria tuberculata, Hutton, "Cat. Tert. Moll. of N.Z.," in part.

I have now no doubt but that *S. tuberculata*, and its variety *β*. of my catalogue, are distinct species, and I propose to retain the name of *tuberculata* for the variety as more appropriate, and to call those forms with spinous tubercles *S. spinosa*. This latter species is found in the Trelissic Basin, etc., while *S. tuberculata* comes from White Rock River, etc.

CYCLOSTREMA OBLIQUATA, n. s.

Shell large, spiral, depressed, smooth (?), with a spiral groove above the periphery. Whorls 4, increasing rather rapidly. Suture deep; umbilicus wide. Aperture oval, very oblique. Peristome continuous, sharp. Greatest diameter, 0·8; least, 0·62; height, 0·63 inch.

Locality. Wanganui.

A single specimen sent by Mr. Drew. As the shell is worn, it is impossible to describe its external surface.

WALDHEIMIA OVALIS, n. s.

Shell thin, elongated, oval, the greatest width rather in front of the middle, tapering gradually towards the beak; front margin rounded. Surface smooth or with very fine concentric growth-lines. Valves nearly equally convex, the brachial valve regularly arched. Lateral margins nearly straight, anterior margin slightly sinuated, concave dorsally. Beak moderate, angled on each side; the foramen rather small, the deltoidal pieces well developed. Loop reaching nearly to the anterior margin, not much expanded; septum extending through half the length of the brachial valve. Length, 2·1; breadth, 1·5; depth, 1·1 inch.

Locality. Wanganui; Napier.

This species combines the shape of *W. vincentiana* with the small foramen of *W. lenticularis*.

Art. LVII.—*The Wanganui System.*

By Captain F. W. Hutton, F.G.S.

[*Read before the Philosophical Institute of Canterbury, 6th August,* 1885.]

Plates XII., XIII.

Dr. von Hochstetter, in 1864, placed the Wanganui River beds with his Hawke's Bay series, in the younger of the two groups into which he divided our tertiary rocks;[1] and he considered them to be of pliocene age. He did not, however, visit the district, and gave no list of fossils obtained from there.

In 1867, Mr. J. Buchanan, of the Geological Survey, made a large collection of fossils from between Wanganui and the Patea, and he divided the rocks into a lower blue clay and upper sandy beds.[2] These fossils were examined by Dr. Hector, who placed the upper sandy beds in the post-tertiary, and the lower blue clay in his upper tertiary or Struthiolaria beds, together with the blue clays of Awatere, Motunau, Awamoa, and other places.[3]

On a re-examination of these fossils, in 1872, I followed Dr. Hector in keeping the upper beds in the pleistocene, but separated the blue clay of Shakespeare Cliff from the other beds associated with it as a separate and younger formation, under the name of the Wanganui Formation.[4] This I considered to be pliocene, and the Awatere series to be upper miocene.

In 1875, Mr. A. McKay referred to the Wanganui Formation some conglomerates and highly fossiliferous sands with pumice overlying the Napier limestone, between Cape Kidnappers and the Mariatotara River.[5]

In 1876, Mr. S. H. Cox ascertained that a considerable thickness of marine strata, with abundance of fossils, mostly recent, were superimposed upon the Napier or Scinde Island limestone, in Hawke's Bay.[6] He gave a list of these fossils, which Dr. Hector pronounced to be the same as those from the upper beds at Wanganui, and he placed the rocks in the Wanganui Formation.[7]

In 1877, Mr. A. McKay traced these beds from the Manawatu Gorge to Napier,[8] giving them the name of Rotella beds. In

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1 "Reise der *Novara*," Geologischer, Theil I., p. xl.

2 "Trans. N.Z. Inst.," vol. ii., p. 163.

3 "Catalogue of the Colonial Museum," Wellington, 1870, p. 172.

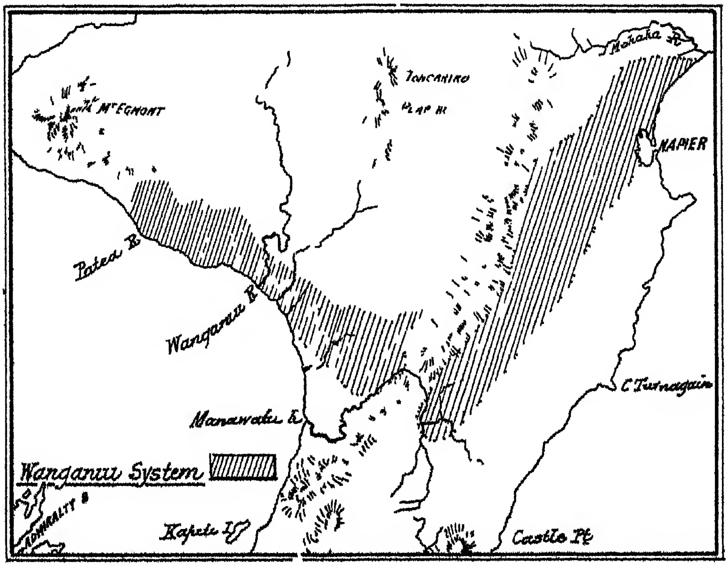
4 "Cat. Tert. Moll. and Echin. New Zealand," Wellington, 1873; and "Quart. Jour. of the Geol. Soc. of London," vol. xxix., p. 373.

5 "Rep. Geol. Expl.," 1874-76, pp. 44 and 49.

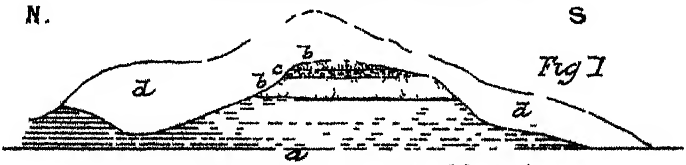
6 "Rep. Geol. Expl.," 1874-76, p. 96.

7 "Rep. Geol. Expl.," 1874-76, pp. viii. and x.

8 "Rep. Geol. Exp.," 1876-77, p. 79.

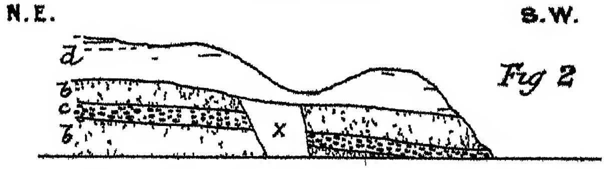


Shakespeare's Cliff



d Silt and gravel. b Sand (fossils)
c. Conglomerate a Blue clay (fossils

Putiki Point.



d Silt and gravel. b Sand with fossils
c Conglomerate X Slipped ground. (Fault).

To accompany Paper by F W Hutton.

the same year, Dr. Hector, in his new classification of formations, considered the upper beds at Wanganui to be pliocene; and he grouped them with the Hawke's Bay beds as the Kereru Rotella beds, subsequently called the Kereru series.[1] The blue clay of Shakespeare Cliff was now called the Wanganui series, and put into the upper miocene. Indeed, the Director of the Geological Survey has never acquiesced in my view that the Shakespeare Cliff clay is younger than the miocene. He has always considered it as upper miocene, placing it formerly with the Awatere series, but last year with the Te Aute limestone; the Awatere series being now made lower miocene.[2] It will thus be seen that the terms "Wanganui formation" or "Wanganui series" have been used sometimes for the upper sandy beds, sometimes for the underlying blue clay.

In January, 1884, I examined the Wanganui District, and came to the conclusion that the upper sandy beds cannot be separated from the blue clay; that all are of pliocene age, and very different, palæontologically, from the Awatere series or the Te Aute limestone. Accordingly, in a paper read to the Geological Society of London, in January, 1885, I proposed a Wanganui system to include both; distinguishing the beds at Wanganui as the Putiki series, those at Hawke's Bay as the Petane series, and those on the west side of the Ruataniwha Plains, in Waipawa County, as the Kereru series;[3] at the same time saying that these series were geographical only, and did not represent different epochs of time. I had not room in that paper to give all the evidence on which I relied for proving that these series formed a distinct system well marked off, both palæontologically and stratigraphically, from the older Pareora system; and the object of the present communication is to furnish this, together with other evidence, which I obtained during a visit to Hawke's Bay last January. However, in order to save space, I have not thought it necessary to give separate lists of the fossils from each locality, but have contented myself with one list of all the species known from the Wanganui system, with the localities in which each has been found. Kereru I have not visited, and have no list of fossils from there; but, according to Mr. McKay, they are the same as those found at Matapiro Station, on the Ngaruroro River. Of course my visits, both to Wanganui and to Hawke's Bay, were far too short to allow me to work out the stratigraphical relations of all the different beds; but I think that what I have seen, together with the large collections of fossils that I have examined, will be sufficient to lay the foundation for a correct classification of the beds, and will enable local geologists to work out the details.

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[1] "Rep. Geol. Exp.," 1876-77, p. 4.
[2] "Rep. Geol. Expl.," 1883, p. 13.
[3] "Quart. Jour. Geol. Soc.," vol. xli., p. 211.

Wanganui District.

The beds near the mouth of the Wanganui River were, I believe, first described by the Hon. W. Mantell in the "Quarterly Journal of the Geological Society of London,"[1] but, unfortunately, I am unable to refer to his papers. In 1867, Mr. J. Buchanan examined the district for the Geological Survey of New Zealand. The results of his researches, together with a section of Shakespeare Cliff, were published in 1869 in the "Transactions of the N.Z. Institute."[2] He divided the rocks into "an upper sandy and lower clay stratum, and separated by a deposit of sand of varying thickness, being at least 12 feet at Shakespeare Cliff, at Wanganui, the whole covered by a heavy deposit of sands and gravels containing a cemented gravel bed, also of variable thickness, the material from which is in common use for the construction of roads throughout the district."

In 1874, Mr. C. W. Purnell read a paper to the Wellington Philosophical Society "On the Wanganui Tertiaries."[3] He divides the beds into three groups. "The oldest fossiliferous stratum within a radius of four or five miles from the town of Wanganui is the tuff [with pumice] in the cliffs on the east bank of the river [at Kaimatera]; the next oldest, the blue clay, at Shakespeare Cliff; and the youngest, the beds overlying the blue clay and those at the Landguard Bluff." Mr. Purnell, however, mistook ordinary clay for "volcanic mud," and he considered the recent alluvial deposits of the river, containing pumice, to pass under the blue clay at Shakespeare Cliff.

In 1875, Mr. Kirk made a collection of fossils from Wanganui for the Wellington Museum.[4]

In 1882, I received from Mr. S. H. Drew, of Wanganui, a collection of fossils made in the neighbourhood, with the request that I would name them for him. It contained several new species, which I described in the "Trans. N.Z. Inst.," vol. xv., p. 410. In 1883, I again received another and much larger collection, which also contained some new forms, and I came to the conclusion that it would be advisable to publish a new list of all the mollusca which had been recorded from this interesting locality. However, before doing so, I wished to examine the district myself. Accordingly, in January, 1884, I paid a visit to Wanganui, and, under Mr. Drew's guidance, spent three days in examining the sections near the town, and one day at Patea, with the following results.

The base of Shakespeare Cliff, which stands on the left bank of the river, opposite to the town of Wanganui, is formed

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[1] "Quart. Jour. Geol. Soc.," vol. iv., p. 239, and vol. vi., p. 332.
[2] "Transactions," vol. ii., p. 163.
[3] "Trans. N.Z. Inst.," vol. vii., p. 453.
[4] "Rep. Geol. Expl.," 1881, p. 128, Nos. 206-208.

of blue clay (Pl. XII., fig. 1, *a*), about 40 feet thick, and full of fossils. A layer of yellow sand (*b*) rests upon this clay, apparently quite conformably; it is about 20 feet thick, and contains broken shells. Then comes a thin bed of sand, about 4 feet thick, with abundance of fossils. Then another bed of sand, about the same thickness, followed by a bed of gravel (*c*) cemented by iron oxide. This is followed by a bed of dark green sand (*b*). All these belong to the Wanganui system; they have suffered much denudation, and are overlain quite unconformably by a series of silts and gravels (*d*) which are unfossiliferous.

At Landguard Bluff, or Putiki, near the mouth of the river on the left bank, the blue clay is not seen, but the upper beds are largely developed. The lowest stratum is yellow sand with broken shells, followed by sand with shells (Fig. 2, *b*), sands and clay, cemented gravel (*c*), and greensand, as at Shakespeare Cliff. But above the greensand is another bed of sand with shells (*b*) and white clay. At the point forming the Bluff, there is a fault of about 30 feet (*x*), caused apparently by a land slip. Round the point some small beds of lignite lie on the cemented gravel. The upper beds are denuded, and overlain unconformably by unfossiliferous silt and gravels, as at Shakespeare Cliff.

The Wanganui system in this district may therefore be represented as follows, the known thickness being between 150 and 200 feet :—

Putiki Series, near Wanganui.

9. White clay, about 4 feet.
8. Sand, about 12 feet.
7. Sand with fossils, about 5 feet.
6. Greensand, current bedded, about 25 feet.
5. Cemented gravel, from 10 to 20 feet.
4. Sand with clay, from 4 to 50 feet.
3. Sand with fossils, from 4 to 10 feet.
2. Sand with broken shells, from 12 to 20 feet.
1. Blue clay with fossils, 40 + feet. Bottom not known.

No pumice has been found in any of these beds. The blue clay is quite conformable to the upper beds, and contains the same fossils. I know 188 species of mollusca from the blue clay, all but 21 of which also occur either in the upper beds or in the Petane series. But of these 21, thirteen are still living in the New Zealand seas, and must therefore have been living when the upper beds were being deposited, although their remains have not yet been found in them. This leaves eight species out of 188, as distinctive of the blue clay, and of these only one—*Vermetus moniliferus*—is found in the Pareora system. This small difference between the fossils of the blue clay and those of the upper beds is easily accounted for by difference of station;

it is much less than the difference between the upper beds and the Petane series. The number of species from the upper sandy beds is 156, of which 72 per cent. are recent; while of the 133 species from the blue clay, 77 per cent. are recent. Evidently we cannot disconnect the blue clay from the upper beds.

On the sea coast at Patea, south of the mouth of the river, blue clay with fossils passes up gradually into a blue micaceous sandy clay, apparently unfossiliferous. Upon this lies about 12 feet of yellow sand; then cemented gravel 4 feet thick, followed by gray sands, and then red and yellow sands. The upper beds form the cliff, and not being very accessible, I did not examine them closely, but I could find no fossils in the tumbled blocks. The sequence is remarkably like that at Wanganui. The yellow sand is distinctly separated from the blue micaceous clay upon which it rests, but without any appearance of unconformity. The number of species obtained from the blue clay is 26, of which 77 per cent. are recent. Three species of Pareora shells, not known from any other part of the Wanganui system, have been found in the blue clay at Patea. They are *Oliva neozelanica*, *Struthiolaria cingulata*, and a species of *Cucullæa* (fragments).

On the left bank of the Wanganui River, about four miles above the town, a very good section is seen at Kaimatera Cliff; but the beds here differ much from those at Putiki Point. The lowest beds seen are a series of sands and silts (Pl. XIII., fig. 8, *a*), without fossils. These are overlain, apparently unconformably, by a bed of sand with shells and numerous small fragments of pumice. This is followed by a thick series of sands much current-bedded (*b*); this again by a loosely cemented gravel-bed (*c*). Over this comes another bed of sand with fossils; the whole being covered unconformably by unfossiliferous silt and gravel (*d*), as at Wanganui. These beds, *b* and *c*, may be called the Kaimatera beds. We obtained, in a few hours, 47 species of shells from these sands, 44 of which, or 93 per cent., were recent. The three supposed extinct species are *Trophon expansus*, *Trochita inflata*, and *Risella melanostoma*. Of these, the two first are closely allied to living species, and the third is abundant in Australia and Tasmania; consequently, I think that these beds are of pleistocene age, and should be kept out of the Wanganui system. Whether the apparent unconformity between *a* and *b* is a real one or not I cannot say, as the upper beds are much current-bedded, and the exposed section is two short to place much dependence on.

Hawke's Bay District.

Dr. Hector was the first to report on this district. He described the tertiary rocks from the Upper Mohaka to Petane,

and considered that that portion lying between Pohui and the Mangapikopiko (=Purohutangihia) Range was an older formation underlying unconformably the limestones of Te Waka and the Purohutangihia.[1]

In 1876, Mr. S. H. Cox considered that the whole of the tertiary rocks from Pohui to Napier formed a single comformable series, which might possibly be divided into upper and lower.[2] In the same year, Mr. Percy Smith recognised an unconformity near Pohui, between the Mangaharuru sandstone and the overlying beds to the south.[3]

In 1877, Mr. A. McKay gave a section along the Ngaruroro River,[4] which, as well as the geological map of the neighbourhood, appears to be very correct in all the places examined by me.

Last January I spent a fortnight in Hawke's Bay, and, accompanied by Mr. A. Hamilton, who had previously sent me many fossils, I examined the section from the Upper Mohaka to Petane, the country about Puketapu, and the valley of the Ngaruroro River, from Hastings to Kikowheru Creek, on Mr. Walter Shrimpton's station of Matapiro. I made the following observations.

In the Upper Mohaka, where the road from Napier to Lake Taupo crosses the river, the rocks are grey or brown argillaceous sandstone (Fig. 4, *a*), containing the following fossils :—*Struthiolaria tuberculata*, *S. sulcata*, and a species of *Cucullæa*. They may be referred with safety to the Pareora system. These beds are very thick, more than 800 feet, and are overlain by a thick stratum of hard shelly limestone (*b*) forming the Te Waka Range, and known as the Pohui limestone. At the Mohaka the beds dip to the S.E., at an angle of 25°, but at Pohui they flatten to S.S.E. 10°.

South of Pohui, we came across a newer series of rocks, resting uncomformably on the denuded surface of the Pohui limestone and the underlying sandstones. This is the commencement of the Petane series. It dips here about S.S.E. 15°, and at Petane not more than 6° to the S.S.E., but a slight anticlinal fold occurs before reaching Petane (fig. 4). The rocks of the series are as follows, in descending order :—

5. Two or more thick bands of limestone, with beds of calcareous sand (Petane limestone), sometimes passing into blue clay (*f*).
4. Brown sandstones, with a band of conglomerate (*e*).
3. Blue clay, known locally as "papa," (*d*).

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1 "Rep. Geol. Expl.," 1870-71, p. 158.
2 "Rep. Geol. Expl.," 1874-76, p. 97.
3 "Trans. N.Z. Inst.," vol. ix., p. 565.
4 "Rep. Geol. Expl.," 1876-77, p. 83, and sec. No. 5.

2. Grey and brown sandstone, with several bands of conglomerate (*c*).
1. Bluish argillaceous sandstone (*c*).

The whole series is estimated by Mr. Percy Smith to be 4,500 feet in thickness. I could detect no pumice in any of these beds, but it occurs in abundance at Titiokura Saddle, between Pohui and the Mohaka,[1] and at other places in beds lying unconformably on the Petane series, as has already been pointed out by Mr. Cox. I know 174 species of mollusca from the upper beds (4 and 5), of which 65 per cent. are recent.

At Puketapu, on the Tutaekuri River, the Petane limestone is largely developed, and can be well studied on both banks of the river at Moteo, a little above Puketapu. Here, amongst other shells, we found a broken and worn fragment of *Pecten triphooki*, which is now in my collection. It is doubtful whether this is a rolled fragment derived from the Napier limestone, or whether it lived during the Wanganui period. If the latter be correct, other specimens will, no doubt, be found. Below the limestone comes a calcareous sandstone, and a little higher up the river this is seen to be underlain by sands and shingle-beds, with fossils, like those at Petane. There is no appearance of the blue clay here; neither could we find the pumice sands, mentioned by Mr. McKay as occurring under the limestone at Puketapu.[2]

At Matapiro Station, on the Ngaruroro River, the limestones and calcareous sands (Pl. XIII., fig. 5, *c*) belonging to the Petane series, which form the tops of the hills, are underlain by a thick bed of sandy clay (*b*); and below this, in the bed of the Kikowheru Creek, occur beds of fine gravel, sand, and thin beds of clay (*a*), dipping S.E. at angles varying from 25° to 6°. These contain abundance of fossils. We collected 96 species, of which 71 per cent. are recent. In some very limited spots the sands are pale yellowish-white and of small specific gravity. These patches may be formed of decomposed pumice, although I could not recognise pumice with certainty by means of a lens. No doubt they are the pumice sands mentioned by Mr. McKay as occurring sparingly in Kikowheru Creek.[3]

Relation to the Pareora System.

No junction between the Wanganui system and the Pareora system has as yet been observed on the western side of the Wellington Provincial District, although the Pareora system undoubtedly exists up the Waitotara River. But on the eastern

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[1] These pumice beds are very different from those which *overlie the river gravels* in the Mohaka Valley.

[2] "Rep. Geol. Expl.," 1876-77, p. 84.

[3] "Rep. Geol. Expl.," 1876-77, p. 88.

N. —Kaimatera Cliff.— S.

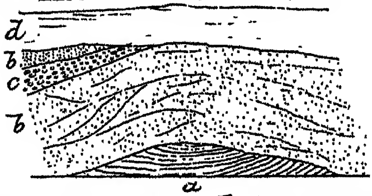
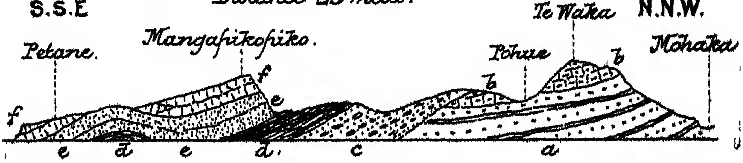


Fig 3.

d. Silt and gravel. b. Sand with pumice. (Fossils).
c. Conglomerate. a. Putiki series?

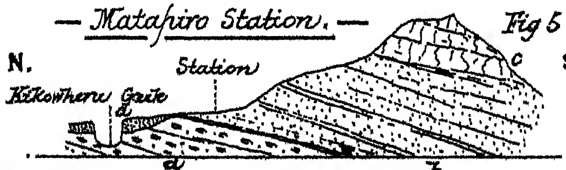
—Petane to the Upper Mohaka.— Fig 4.

Distance 23 miles.



f. Petane Limestone &c. c. Brown & bluish Sandstone.
e. Brown Sandstone. b. Pohue or Te Aute Limestone.
d. Blue clay. a. Grey & brown Sandstone.
a. and b. belong to the Pareora System.

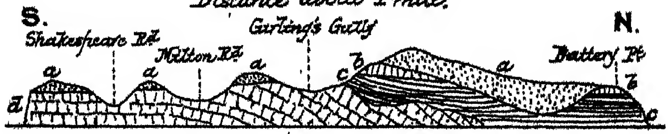
— Matapiro Station. — Fig 5



d River gravels. b Blue sandy clay.
c. Petane Limestone &c. a. Sands & gravels.

—— Section through Scinde Island. ——

Distance about 1 mile.



a. Brick earth, or loam, with Pumice .... Pleistocene.
b. Limestone } Petane Series .... Pliocene.
c. Sandstone }
d. Scinde Id. Limestone & Ahuriri Series ...... Miocene.

To accompany Paper by F. W. Hutton.

side of the Wellington Provincial District, and in Hawke's Bay, several junctions occur.

1. At Pohui, on the Napier and Taupo Road, an unconformity exists, as was first pointed out by Mr. Percy Smith. (*See* fig. 4.) According to Mr. Percy Smith, this unconformity is very plain some 12 or 14 miles north of the road, where the lowest beds of the Petane series, called "Middle Papa" by Mr. Smith, dipping at an angle of about 10°, abut against the steep face of the "Maungaharuru sandstone" (Pareora system) at an angle of 29° 30′. "This unconformity," Mr. Smith says, "is a marked feature in viewing the country anywhere near the line of strike of the beds, where the older strata . . . are seen dipping at a considerable angle, forming hills which are quite characteristic and different in shape to the Papa hills of the overlying formation."[1]

2. At Napier, the unconformity between the two systems is quite clear; but this I have described in another paper read this year to the Institute ("On the Geology of Scinde Island").

3. Further south, Mr. McKay has shown complete unconformity between the two systems at Mount Vernon, near Waipukurau.[2]

4. In the East Wairarapa the pliocene beds on the east side of Palliser Bay, which probably belong to the Wanganui system, are said by Mr. McKay to be unconformable to the upper miocene rocks (Pareora system) upon which they rest.[3]

5. Again, Dr. Hector has shown that the pliocene (Wanganui) and miocene (Pareora) systems are unconformable at Oneira in Taranaki.[4]

We may, therefore, confidently assert that there is a wide spread unconformity between these two systems, and that they are separated by a period of elevation during which denudation was active.

Of the 279 species of mollusca known from the Wanganui system, 179 are not found in the Pareora or older rocks. While of 233 species found in the Pareora system, 130 are not found in the Wanganui system, nor in the seas of New Zealand.[5] The palæontological break is, therefore, well marked. The principal characteristics of the Wanganui system are the presence of *Trophon*, *Columbella*, *Turricula*, and *Mytilicardia*; as well as the

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[1] "Trans. N.Z. Inst.," vol. ix., p. 568, pl. xiii., sec. No. 2. In section No. 1 of this paper, No. 7 (Middle Papa) should evidently be No. 9 (gritty sandstone). No. 7 apparently thins out to the south before reaching Pohui, as mentioned by Mr. Smith on page 569.

[2] "Rep. Geol. Expl.," 1878-79, p. 72.

[3] "Rep. Geol. Exl.," 1878-79, p. 84.

[4] "Rep. Geol. Expl.," 1866-67, p. 2, and section.

[5] The discrepancy between these numbers is owing to three species of recent mollusca occurring in the Pareora system, none of which have as yet been found in the Wanganui system.

absence of *Peristernia*, *Nassa*, *Mitra*, *Conus*, and *Limopsis*, all of which occur in the Pareora system. Also, in the Wanganui system, the species of *Turritella*, *Dentalium*, *Cytherea*, *Cardium*, *Pecten*, and *Ostrea*, are small in comparison with the large species of each of these genera found in the Pareora system.

Divisions of the Wanganui System.

The following ten or eleven species of Pareora mollusca have been found in the Petane series, but not at Wanganui nor at Patea:—*Siphonalia nodosa* var. *conoidea*; *Pleurotoma pagoda*, *Natica gibbosa*, *Struthiolaria frazeri*, *Trochita alta*, *Turritella ambulacrum*, *Venus meridionalis*, *Cardita patagonica*, *Perna*, sp. ind.; *Pecten triphooki* (?), *Pecten semiplicatus*. I therefore suppose that this series is older than the blue clay of Shakespeare Cliff. This opinion is confirmed by the percentage of living species found in the beds, which is 65 to 71 per cent. in the Petane series, and 72 to 77 per cent. in the Putiki series. We may therefore provisionally divide the Wanganui system into two series, which may perhaps overlap in time:—

2. *Putiki Series*, including the blue clay of Shakespeare Cliff and Patea.
1. *Petane Series*, from the River Esk to the Ngaruroro.

The Kaimatera beds should be separated from both these series, and referred probably to the pleistocene period.

The position of the Kereru series still remains uncertain, as no list of fossils from that locality has as yet been published. According to Mr. McKay,[1] and to Mr. Cox,[2] the series contains considerable quantities of pumice sand, and possibly, therefore, it is on the same horizon as the Kaimatera beds.

The value of taking the percentage of recent species of mollusca in a tertiary rock, as a test of its relative age, has sometimes been called in question. This has arisen, I think, from a misconception of the limits of the method. If it be true that species have gradually changed, or that they have been gradually introduced into an area—which no one disputes—then it must be true that, in each epoch, the nearer we approach to the present time the nearer must be the resemblance between the fauna of the epoch and that of the present time. Indeed, the same holds good if, instead of assuming gradual change, we assume that the ancient fauna was altered by successive migrations into the area; for it is evident that the percentage test would be of great value here in ascertaining the relative ages of the various migrations; for each migration would bring many species similar to or allied to those now living, consequently the percentage system is of the greatest importance in testing

[1] "Rep. Geol. Expl.," 1876-77, p. 82.
[2] "Rep. Geol. Expl.," 1882, p. 3.

the relative ages of any two sets of beds belonging to the same biological province. But it does not follow that this method can be trusted for correlating with accuracy sets of beds in widely distant areas. On the contrary, different districts have undergone different physical changes, and we have therefore every reason to suppose that alterations in floras and faunas would proceed with unequal rapidity in different parts of the world. At the same time, as the replacement of a whole marine fauna can rarely be sudden, it follows that the percentage system has some value even here. But it must always be used in conjunction with a comparison of the specific forms of the two areas. And here, again, it is only the wide ranging oceanic, or deep sea species—such as sharks, cephalopods, and a few bivalves—which should be depended upon for evidence, but these wide ranging forms are of the very greatest value in correlating strata all over the world.

In the present case we have no wide ranging species that can help us in determining the European equivalent of the Wanganui system, and the percentage of recent species is our only resource. All geologists, however, would, I think, allow that it belongs to pliocene, the only question being: to what part of the pliocene should it be referred? and this may be left for the present undecided. Excluding the Kaimatera beds there are 278 species of mollusca known from the system, and of these 63 per cent. only are recent. This percentage is, however, likely to be increased, as many of the supposed extinct species are minute, and may have been overlooked as living forms. The reason the percentage of recent species is less in the whole system than in any of its separate series or beds, is that the recent species are more abundant individually, and more widely distributed, than the extinct forms, which are usually rare and local. The following genera, found in the Wanganui system, are not known to live in the seas of New Zealand:—*Ringicula*, *Oliva*, *Sigaretus*, *Eulima*, *Eulimella*, *Admete*, *Cerithium*, *Rissella*, *Lutraria*, *Loripes*, *Macrodon*, *Cucullæa* (?), *Perna*; but probably those genera which contain minute species only will yet be detected.

Of the localities attached to the species in the following list, "Putiki" means the upper sandy beds of the Wanganui system in the neighbourhood of Wanganui. "Shakespeare Cliff" means the blue clay at Shakespeare Cliff, and on the sea coast near Wanganui. "Petane" means the district round Petane, including Napier and Puketapu.

Descriptions of the corals and Bryozoa from Wanganui will be found in the "Palæontology of New Zealand," part iv., by the Rev. J. Tenison-Woods (Wellington, 1880). A few Bryozoa from

Petane are mentioned by Mr. Waters in the "Quarterly Journal of the Geological Society of London," vols. xxxix. and xl., and a list by Mr. G. R. Vine, junr., of the Foraminifera from Petane, is given by Mr. A. Hamilton, in the "Transactions of the New Zealand Institute," vol. xiii., p. 393.

Mollusca of the Wanganui System.

CEPHALOPODA.

1. *Sepia*, sp.
Petane. Two small delicate mucrones, apparently belonging to this genus.

GASTROPODA.

Pulmonata.

2. *Patula coma*, Gray, in Dieffenbach's "New Zealand," vol. ii., p. 263.
Petane.

3. *Therasia thaisa*, Hutton, "Trans. N.Z. Inst.," vol. xvi., p. 182.
Petane; Matapiro.

4. *Amphibola avellana*, Chemnitz, "Conch. Cab.," vol. v., f. 1919, 1920.
Napier.

Opisthobranchiata.

5. *Ringicula uniplicata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 313.
Petane.

6. *Tornatina pachys*, Watson, "Lin. Soc. Jour.," vol. xvii., p. 331.
Wanganui; Petane; Shakespeare Cliff.

7. *Tornatella alba*, Hutton, "Cat. Marine Moll. of N.Z.," p. 51 (*Buccinulus*).
Shakespeare Cliff; Wanganui.

8. *Tornatella kirki*, Hutton, "Cat. Marine Moll. of N.Z.," p. 51 (*Buccinulus*).
Shakespeare Cliff. Rare. Perhaps a variety of the last species.

9. *Cylichna striata*, Hutton, "Cat. Marine Moll. of N.Z.," p. 52.
Petane. Found also in the Pareora system.

Protobranchiata.

10. *Murex angasi*, Crosse, "Jour. de Conch.," vol. xi., p. 86, pl. 1 (*Typhis*); *T. zealandica*, Hutton, "Cat. Tert. Moll. of N.Z.," p. 2.
Shakespeare Cliff.

11. *Murex neozelanicus*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool., ii., p. 529, pl. 36, f. 5–7.
Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

12. *Murex octagonus*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool., ii., p. 531, pl. 36, f. 8–9.
Shakespeare Cliff; Wanganui.

13. *Murex espinosus*, Hutton, "Trans. N.Z. Inst.," vol. xviii.
Petane; Matapiro.

14. *Trophon ambiguus*, Philippi, Abbild., *Fusus*, pl. 1, f. 2.
Wanganui; Kaimatera; Petane; Matapiro; Shakespeare Cliff.

15. *Trophon cretaceus*, Reeve, "Conch. Icon.," *Fusus*, f. 48.
Wanganui; Shakespeare Cliff. A large series of specimens have led me to think that this species is distinct from the last. It is distinguished by the more numerous spiral ribs.

16. *Trophon stangeri*, Gray, (*Fusus*), "Dieff. N.Z.," vol. ii., p. 230.
Wanganui; Kaimatera.

17. *Trophon cheesemani*, Hutton, (*Purpura*), "Trans. N.Z. Inst.," vol. xv., p. 131.
Wanganui; Kaimatera.

18. *Trophon duodecimus*, Gray, in "Dieff. N.Z.," vol. ii., p. 230.
Wanganui; Kaimatera; Petane; Matapiro; Shakespeare Cliff.

19. *Trophon crispus*, Gould, (*Fusus*), "Pro. Bost. Soc. Nat. Hist." vol. iii., p. 141.
Wanganui; Petane; Matapiro; Shakespeare Cliff. Still living at Terra del Fuego. Our species may be distinct.

20. *Trophon expansus*, Hutton, "Trans. N.Z. Inst.," vol. xv., p. 410.
Wanganui; Kaimatera; Petane; Matapiro; Shakespeare Cliff.

21. *Trophon plebeius*, Hutton, (*Fusus*), "Cat. Marine Moll. of N.Z.," p. 9.
Wanganui; Kaimatera; Petane; Matapiro; Shakespeare Cliff.

22. *Polytropa striata*, Martyn, "Univ. Conch.," pl. 7 (*Buccinum*).
Kaimatera.

23. *Fusus australis*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool., ii., p. 495, pl. 34, f. 9–14.
Wanganui; Kaimatera; Shakespeare Cliff.

24. *Fusus spiralis*, Adams, "Pro. Zool. Soc.," 1855, p. 221.
Petane; Shakespeare Cliff.

25. *Taron dubius*, Hutton, (*Trophon*), "Jour. de Conch.," xxvi., p. 13.
Wanganui.

26. *Siphonalia mandarina*, Duclos, "Mag. Zool.," viii.
Wanganui; Kaimatera; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

27. *Siphonalia caudata*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. ii., p. 503, pl. 34, f. 20–21.
Wanganui. Found also in the Pareora system. Perhaps a variety of the last.

28. *Siphonalia dilatata*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. ii., p. 498, pl. 34, f. 15–16. *Fusus subreflexus*, Sowb. in "Darwin's Geol. Obs. in S. America."
Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

29. *Siphonalia nodosa*, Martyn, "Univ. Conch.," *Buccinum*, pl. 5. *S. nodosa*, var. B. (Hutton), is the young.
Kaimatera; Shakespeare Cliff; Patea; Petane; Matapiro. Found also in the Pareora system.

Var. *conoidea*, Hutton; *S. nodosa*, var. D., Hutton, "Cat. Tert. Moll. of N.Z."
Petane; Matapiro. Found also in the Pareora system. Possibly the same as *Purpura conoidea*, Zittel.

30. *Siphonalia subnodosa*, Hutton, "Trans. N.Z. Inst.," vol. ix., p. 596, pl. xvi., f. 7 (*Cominella*); *S. nodosa*, var. C., Hutton, "Cat. Tert. Moll. of N.Z."
Shakespeare Cliff; Matapiro. Found also in the Pareora system.

31. *Siphonalia* (?) *cingulata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 315.
Shakespeare Cliff; Petane.

32. *Pisania lineata*, Martyn, "Univ. Conch.," *Bucc.*, pl. 48.
Wanganui; Kaimatera; Petane; Shakespeare Cliff. Found also in the Pareora system.

Var. *traversi*, Hutton, "Cat. Marine Moll. of N.Z.," p. 9 (*Fusus*).
Wanganui.

33. *Pisania striatula*, Hutton; *Cominella striata*, Hutton, "Trans. N.Z. Inst.," vol. vii., p. 458; not *Pisania striata*, Gml.
Wanganui; Petane; Matapiro; Shakespeare Cliff.

34. *Pisania drewi*, Hutton, "Trans. N.Z. Inst.," vol. xv., p. 410.
Wanganui; Petane.

35. *Cominella maculata*, Martyn, "Univ. Conch.," *Bucc.*, pl. 49.
Wanganui; Matapiro (a large variety). Found also in the Pareora system.

36. *Cominella maculosa*, Martyn, "Univ. Conch.," *Bucc.*, pl. 8.
Petane.

37. *Cominella virgata*, Adams, "Gen. Moll.," pl. 16, f. 6*a*.
Shakespeare Cliff; Kaimatera.

38. *Cominella antarctica*, Reeve, "Conch. Icon.," *Buccinum*, f. 30.
Petane; Matapiro.

39. *Cominella accuminata*, Hutton; *C. elongata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 315, pl. 18, f. 5; not *C. elongata*, Dunker.
Shakespeare Cliff.

40. *Cominella lurida*, Philippi, "Zeitschrift f. Malak." 1848, p. 187.
Wanganui; Petane; Matapiro; Shakespeare Cliff.

41. *Cominella nassoides*, Reeve, "Conch. Icon.," *Buccinum*, f. 12.
Petane.

42. *Cominella huttoni*, Kobelt, "Cat. d. Gattung," *Cominella*, p. 233.
Matapiro.

43. *Oliva neozelanica*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 314, pl. 18, f. 1.
Patea. Found also in the Pareora system.

44. *Ancillaria australis*, Sowb., "Sp. Conch.," 1830, pl. 7, f. 44–46.
Kaimatera; Wanganui; Patea; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

45. *Ancillaria lata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 325.
Patea; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

46. *Columbella varians*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 314, pl. 18, f. 2.
Petane; Shakespeare Cliff.

47. *Columbella choava*, Reeve, "Conch. Icon.," f. 289.
Wanganui; Petane; Shakespeare Cliff.

48. *Columbella pisaniopsis*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 314.
Petane; Matapiro.

49. *Columbella cancellaria*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 314.
Wanganui; Petane.

50. *Columbella angustata*, Hutton, "Trans. N.Z. Inst.," vol. xviii.
Petane.

51. *Marginella translucida*, Sowb., "Thes. Conch.," vol. i., p. 376.
Wanganui; Petane; Matapiro. Found living in Australia. This may be the *M. propinqua* (Tate), referred to by Mr. T. W. Kirk in "Trans. N.Z. Inst.," vol. xiv., p. 409.

52. *Marginella attenuata*, Reeve, "Conch. Icon.," f. 116; *M. hectori*, Kirk, "Trans. N.Z. Inst., vol. xiv., p. 409.
Petane. Found living in Australia.

53. *Marginella angasi*, Brazier, "Jour. de Conch.," 1870, p. 304.
Wanganui. Found living in Australia.

54. *Voluta pacifica*, Solander, "Cat. Portland Mus.," No. 4039
Shakespeare Cliff; Patea; Petane; Matapiro; Wanganui. Found also in the Pareora system.

Var. *elongata*, Swainson, "Exot. Conch.," pl. 20, 21.

Wanganui. Found also in the Pareora system.

55. *Voluta gracilis*, Swainson, "Exot. Conch.," pl. 42, 43.
Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

56. *Turricula rubiginosa*, Hutton, (*Mitra*), "Cat. Marine Moll. of N.Z." p. 20.
Wanganui; Petane.

57. *Turricula marginata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 315, pl. 18, f. 4.
Wanganui.

58. *Turricula planata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 315, pl. 18, f. 3.
Wanganui.

59. *Turricula lincta*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 326.
Petane.

60. *Terebra tristis*, Deshayes, "Pro. Zool. Soc.," 1859.
Shakespeare Cliff; Kaimatera; Patea; Petane.

61. *Terebra costata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 315, pl. 18, f. 6.
Wanganui; Petane; Matapiro. Found also in the Pareora system.

62. *Pleurotoma pagoda*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 5.
Petane; Matapiro. Found also in the Pareora system.

63. *Pleurotoma albula*, Hutton, "Cat. Marine Moll. of N.Z." p. 12.
Petane; Matapiro. Found also in the Pareora system.

64. *Pleurotoma nexilis*, Hutton, "Trans. N.Z. Inst." vol. xvii., p. 317, pl. 18, f. 9. (*Clathurella?*)
Wanganui; Petane.

65. *Pleurotoma buchanani*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 4.
Wanganui; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

66. *Pleurotoma neozelanica*, Smith, "Ann. and Mag. Nat. Hist.," series 4, vol. xix., p. 492.
Petane; Shakespeare Cliff.

67. *Pleurotoma tuberculata*, Kirk, "Trans. N.Z. Inst.," vol. xiv., p. 409.
Petane.

68. *Pleurotoma plicatella*, Hutton, "Trans. N.Z. Inst." vol xviii.
Wanganui.

69. *Drillia maorum*, Smith, "Ann. and Mag. Nat. Hist.," series 4, vol. xix., p. 497.
Petane.

70. *Drillia lævis*, Hutton, "Cat. Marine Moll. of N.Z.," p. 12.
Petane; Shakespeare Cliff.

71. *Drillia alabaster*, Reeve, "Pro. Zool. Soc.," 1843, p. 181.
Wanganui; Matapiro. Found living in Australia.

72. *Drillia wanganuiensis*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 4.
Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system. Much like *P. subæqualis*, Sowb., in Darwin's "Observations on the Geology of S. America."

73. *Drillia æquistriata*, Hutton, "Trans. N.Z. Inst.," vol. xviii.
Petane.

74. *Drillia protensa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 317 (*Daphnella*).
Petane.

75. *Daphnella lymneiformis*, Kiener, *Pleurot.* 62, t. 22, f. 3.
Shakespeare Cliff.

76. *Daphnella striata*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 5 (*Bela*).
Petane; Shakespeare Cliff. Found also in the Pareora system.

77. *Daphnella lacunosa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 317.
Shakespeare Cliff.

78. *Clathurella dictyota*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 316, pl. 18, f. 8.
Wanganui; Petane.

79. *Clathurella sinclairi*, Smith, "Ann. and Mag. Nat. Hist.," series 5, vol. xiv., p. 320.
Wanganui; Petane; Shakespeare Cliff.

80. *Clathurella hamiltoni*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 316, pl. 18, f. 7.
Petane; Matapiro; Wanganui (small variety).

81. *Clathurella abnormis*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 316.
Petane.

82. *Triton spengleri*, Lamarck, "Anim. sans Vert., ed. 2, vol. ix., p. 627.
Wanganui. Found also in the Pareora system.

83. *Cassis pyrum*, Lamarck, "Anim. sans Vert.," ed. 2, vol. x., p. 33.
Wanganui; Shakespeare Cliff.

84. *Natica neozelanica*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. ii., p. 237, pl. 66, f. 11, 12.
Wanganui; Kaimatera; Patea; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

85. *Natica gibbosa*, Hutton, "Trans. N.Z. Inst.," vol. xviii.
Matapiro. A single specimen, found by Mr. Hamilton.

86. *Natica ovata*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 9.
Wanganui; Patea. Found also in the Pareora system.

87. *Natica australis*, Hutton, (*Luvatia*), "Jour. de Conch.," vol. xxvi., p. 23.
Wanganui; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

88. *Natica vitrea*, Hutton, "Cat. Marine Moll. of N.Z.," p. 21.
Shakespeare Cliff.

89. *Natica lævis*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 317, pl. 18, f. 10.
Petane; Shakespeare Cliff.

90. *Sigaretus undulatus*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 318, pl. 18, f. 11.
Petane; Shakespeare Cliff.

91. *Sigaretus cinctus*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 318, pl. 18, f. 12.
Wanganui.

92. *Eulima treadwelli*, Hutton; *E. micans*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 318; not of Tenison-Woods.
Wanganui.

93. *Eulima media*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 318, pl. 18, f. 13.
Wanganui.

94. *Turbonilla neozelanica*, Hutton, "Cat. Marine Moll. of N.Z.," p. 22 (*Chemnitzia*).
Wanganui; Petane.

95. *Eulimella deplexa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 318.
Wanganui.

96. *Eulimella obliqua*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 318.
Petane.

97. *Aclis costellata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 319, pl. 18, f. 14.
Wanganui.

98. *Odostomia sulcata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 319, pl. 18, f. 15.
Wanganui; Shakespeare Cliff.

99. *Odostomia georgiana*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 319, pl. 18, f. 16.
Petane; Shakespeare Cliff.

100. *Odostomia lactea*, Angas, "Pro. Zool. Soc.," 1867, p. 112, pl. 13, f. 11.
Wanganui; Petane; Matapiro; Shakespeare Cliff.

101. *Odostomia fasciata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 320.
Wanganui.

102. *Odostomia sheriffii*, Hutton, "Trans. N.Z. Inst.," vol. xv., p. 411.
Wanganui.

103. *Odostomia rugata*, Hutton; *O. plicata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 319, pl. 18, f. 17; not of Montfort.
Wanganui; Petane. Found also in the Pareora system.

104. *Trivia neozelanica*, Kirk, "Trans. N.Z. Inst.," vol. xiv., p. 409.
Petane; Matapiro.

105. *Cancellaria trailli*, Hutton, "Cat. Marine Moll. of N.Z.," p. 26.
Wanganui; Petane.

106. *Cancellaria lacunosa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 320.
Petane.

107. *Admete ambigua*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 320, pl. 18, f. 18.
Wanganui.

108. *Trichotropis inornata*, Hutton, "Cat. Marine Moll. of N.Z., p. 26.
Petane; Matapiro; Shakespeare Cliff.

109. *Cerithium cancellatum*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 12.
Petane; Shakespeare Cliff. Found also in the Pareora system.

110. *Bittium terebelloides*, Martens, "Critical List of N.Z. Moll.," p. 26.
Wanganui; Petane.

111. *Bittium cinctum*, Hutton, "Trans. N.Z. Inst.," vol. xviii.
Wanganui; Petane.

112. *Cerithidea bicarinata*, Gray, in "Dieff. N.Z.," vol. ii., p. 241.
Wanganui; Kaimatera; Patea; Napier; Matapiro.

113. *Cerithidea tricarinata*, Hutton, "N.Z. Journal of Science," vol. i., p. 477.
Petane; Matapiro.

114. *Struthiolaria papulosa*, Martyn, "Univ. Conch.," pl. 54.
Wanganui; Shakespeare Cliff.

115. *Struthiolaria frazeri*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 329.
Matapiro. Found also in the Pareora system.

116. *Struthiolaria vermis*, Martyn, "Univ. Conch.," pl. 53.
Wanganui; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

117. *Struthiolaria cingulata*, Zittel, "Reise der *Novara*," Palæ., p. 35, taf. xv., f. 2.
Patea. A single specimen, collected by Mr. Buchanan. Found also in the Pareora system.

118. *Trochita neozelanica*, Lesson, "Voy. *Coquille*," Zool., vol. ii., p. 395.
Wanganui; Kaimatera; Patea; Napier; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

119. *Trochita inflata*, Hutton, "Trans. N.Z. Inst.," vol. xv., p. 411.
Wanganui; Kaimatera; Shakespeare Cliff.

120. *Trochita scutum*, Lesson, "Voy. *Coquille*," Zool., vol. ii., p. 395.
Wanganui; Petane; Matapiro; Shakespeare Cliff; Kaimatera.

121. *Trochita alta*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 329.
Petane; Matapiro. Found also in the Pareora system.

123. *Crepidula costata*, Sowb., "Gen. Shells," f. 3.
Wanganui; Patea; Petane; Matapiro; Shakespeare Cliff.

124. *Crepidula monoxyla*, Lesson, "Voy. *Coquille*," Zool., vol. ii., p. 391.
Wanganui; Kaimatera; Patea; Napier; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

125. *Crepidula unguiformis*, Lamarck, "Anim. sans Vert.," ed. 2, vol. viii., p. 642.
Wanganui; Petane; Shakespeare Cliff. Found also in the Pareora system.

126. *Hipponyx uncinatus*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 14.
Shakespeare Cliff.

127. *Turritella rosea*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 136, pl. 55, f. 24–26.
Wanganui; Kaimatera; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

128. *Turritella ambulacrum*, Sowb., in Darwin's "Geol. Obs. on S. America," p. 257, pl. 3, f. 49; *T. bicincta*, Hutton, "Cat. Tert. Moll.," p. 13.
Petane; Matipiro. Found also in the Pareora system.

129. *Turritella tricincta*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 13.
Wanganui; Kaimatera; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

130. *Turritella pagoda*, Reeve, "Conch. Icon.," f. 60.
Wanganui; Shakespeare Cliff. Found also in the Pareora system.

131. *Eglisia planostoma*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 320, pl. 18, f. 19.
Wanganui; Petane.

132. *Rissoa emarginata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 320, pl. 18, f. 20.
Wanganui; Petane.

133. *Rissoa semisulcata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 231.
Wanganui; Petane.

134. *Rissoa rugosa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 231.
Petane.

135. *Rissoa impressa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 231.
Petane.

136. *Rissoa annulata*, Hutton, "N.Z. Journal of Science," vol. ii., p. 173.
Wanganui; Petane.

137. *Rissoa gradata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 321, pl. 18, f. 21.
Wanganui; Petane.

138. *Rissoa rugulosa*, Hutton, "Cat. Marine Moll. of N.Z.," p. 28.
Petane.

139. *Potamopyrgus corolla*, Gould, "Pro. Bost. Soc. Nat. Hist.," vol. ii.
Matapiro.

140. *Potamopyrgus antipodus*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 241.
Matapiro.

141. *Risella melanostoma*, Gml., in Linné's "Syst. Nat.," ed. 13, p. 3581, No. 90.
Wanganui; Kaimatera.

142. *Vermetus moniliferus*, "Hutton, Cat. Tert. Moll. of N.Z.," p. 13.
Shakespeare Cliff. Found also in the Pareora system.

143. *Vermetus neozelanicus*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 293.
Shakespeare Cliff.

144. *Xenophora conchiliophora*, Born.
Petane. A doubtful determination. Found also in the Pareora system.

145. *Scalaria zelebori*, Frauenfeld, "Reise der *Novara*," Moll., pl. 1, f. 6; *S. intermedia*, Hutton, "Cat. Tert. Moll. of N.Z.," p. 10.

Wanganui; Petane; Shakespeare Cliff. Found also in the Pareora system.

146. *Scalaria nympha*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 321.

Petane.

147. *Scalaria* (?) *corulum*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 322, pl. 18, f. 22.

Wanganui.

148. *Turbo smaragdus*, Martyn, "Univ. Conch.," pl. 73, 74.

Napier.

149. *Turbo granosus*, Martyn, "Univ. Conch.," *Trochus*, pl. 37.

Wanganui.

150. *Imperator imperialis*, Chemnitz, "Conch. Cab.," vol. v., p. 13, f. 1714, 1715.

Wanganui; Shakespeare Cliff.

151. *Rotella neozelanica*, Hombron and Jacquinot, "Voy. Pole Sud," Zool. v., p. 53, pl. 14, f. 5, 6.

Wanganui; Kaimatera; Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

152. *Trochus viridis*, Gml., from Chemn. "Conch. Cab.," vol. v., f. 1643, 1644.

Wanganui.

153. *Trochus conicus*, Hutton, "Trans. N.Z. Inst.," vol. xv., p. 411.

Shakespeare Cliff.

154. *Trochus tiaratus*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 256, pl. 64, f. 6–11.

Wanganui; Kaimatera; Shakespeare Cliff; Petane; Matapiro.

155. *Trochus chathamensis*, Hutton, "Cat. Marine Moll. of N.Z.," p. 36.

Wanganui.

156. *Zizyphinus decarinatus*, Perry, "Conch.," *Trochus*, pl. 47, f. 2.

Wanganui.

157. *Zizyphinus ponderosus*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 322.

Wanganui.

158. *Zizyphinus selectus*, Chemnitz, "Conch. Cab.," vol. xi., f. 1896, 1897.

Kaimatera; Shakespeare Cliff; Petane.

159. *Zizyphinus hodgei*, Hutton, "Trans. N.Z. Inst.," vol. vii., p. 458, and fig.
Shakespeare Cliff; Petane; Matapiro.

160. *Zizyphinus punctulatus*, Martyn, "Univ. Conch.," pl. 37.
Shakespeare Cliff; Petane. Found also in the Pareora system.

161. *Cantharidus tenebrosus*, Adams, "Pro. Zool. Soc," 1851, p. 170.
Shakespeare Cliff; Petane. Found also in the Pareora system.

162. *Cantharidus sanguineus*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 238 (*Gibbula*).
Wanganui; Petane.

163. *Cantharidus pupillus*, Gould, "Pro. Bost. Soc. Nat. Hist.," vol. iii., p. 91.
Shakespeare Cliff; Petane.

164. *Monilea egena*, Gould, "Pro. Bost. Soc. Nat. Hist.," vol. iii., p. 84 (*Solarium*).
Wanganui; Kaimatera; Shakespeare Cliff; Petane; Matapiro.

165. *Monodonta æthiops*, Gmelin, after Chemnitz, "Conch. Cab.," vol. v., f. 1820–1.
Wanganui; Kaimatera.

166. *Monodonta melaloma*, Menke, "Moll. Novæ Holl.," No. 50., p. 14.
Wanganui.

167. *Monodonta sulcata*, Wood.
Wanganui.

168. *Monodonta subrostrata*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 238.
Petane.

169. *Cyclostrema obliquata*, Hutton, "Trans. N.Z. Inst.," vol. xviii.
Wanganui.

170. *Scissurella mantelli*, Woodward, "Pro. Zool. Soc.," 1859, p. 202, pl. 46.
Petane.

171. *Haliotis rugoso-plicata*, Chemnitz, "Conch. Cab.," vol. x., p. 311.
Matapiro.

172. *Fissurella monilifera*, Hutton, "Cat. Marine Moll. of N.Z.," p. 42.
Shakespeare Cliff; Petane.

173. *Emarginula striatula*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 332, pl. 68, f. 21, 22.
Wanganui; Kaimatera; Shakespeare Cliff; Petane. Found also in the Pareora system.

174. *Parmophorus intermedius*, Reeve, "Pro. Zool. Soc.," 1842, p. 50.
Shakespeare Cliff; Petane; Matapiro.

175. *Acmæa corticata*, Hutton, "Man. N.Z. Moll.," p. 89.
Wanganui.

176. *Acmæa flammea*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 354, pl. 71, f. 15–24.
Shakespeare Cliff; Petane.

177. *Chiton pellis-serpentis*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 381, pl. 74, f. 17–22.
Shakespeare Cliff.

178. *Acanthochiton neozelanica*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 400, pl. 73, f. 5–8.
Petane.

SCAPHOPODA.

179. *Dentalium conicum*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 1.
Wanganui; Shakespeare Cliff; Patea; Petane. Found also in the Pareora system.

180. *Dentalium nanum*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 1.
Shakespeare Cliff; Petane; Matapiro.

181. *Dentalium ecostatum*, Kirk, "Trans. N.Z. Inst.," vol. xiii., p. 306.
Shakespeare Cliff; Petane. Found also in the Pareora system.

LAMELLIBRANCHIATA.

182. *Barnea similis*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 254.
Matapiro; Kaimatera.

183. *Pholadidea tridens*, Gray, in "Dieffenbach N.Z.," vol. ii. p. 254.
Wanganui.

184. *Saxicava australis*, Lamarck, "Anim. sans Vert.," 2nd ed., vol. v., p. 153.
Petane.

185. *Panopæa neozelanica*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 547, pl. 83, f. 7–9.
Wanganui; Petane; Matapiro. Found also in the Pareora system.

186. *Corbula erythrodon*, Lamarck, "Anim. sans Vert.," 2nd ed., vol. vi., p. 138.
Wanganui; Shakespeare Cliff; Petane; Matapiro; Kaimatera.

187. *Corbula neozelanica*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 511, pl. 85, f. 12–14.
Wanganui.

188. *Anatina angasi*, Sowerby.
Shakespeare Cliff.

189. *Thracia vitrea*, Hutton, "Cat. Marine Moll. of N.Z.," p. 61; *T. granulosa*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 19.
Wanganui.

190. *Myodora striata*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 537, pl. 83, f. 10.
Wanganui; Shakespeare Cliff; Petane.

191. *Myodora neozelanica*, Smith, "Pro. Zool. Soc.," 1880, p. 584, pl. 53, f. 5.
Wanganui.

192. *Myodora subrostrata*, Smith, "Pro. Zool. Soc.," 1880, p. 584, pl. 53, f. 6.
Wanganui. Found also in the Pareora system.

193. *Myodora antipoda*, Smith, "Pro. Zool. Soc.," 1880, p. 585, pl. 53, f. 7.
Shakespeare Cliff.

194. *Myodora boltoni*, Smith, "Pro. Zool. Soc.," 1880, p. 585, pl. 53, f. 9.
Matapiro.

195. *Mactra discors*, Gray, "Mag. Nat. Hist.," 1837, p. 371.
Wanganui; Shakespeare Cliff; Patea; Matapiro. Found also in the Pareora system.

196. *Mactra æquilatera*, Deshayes, "Pro. Zool. Soc.," 1853, p. 17; *M. elegans*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 19 (juv.)

197. *Mactra scalpellum*, Deshayes, "Pro. Zool. Soc.," 1854, p. 335.
Wanganui; Petane.

198. *Mactra lavata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 321.
Petane.

199. *Hemimactra notata*, Hutton, "Cat. Marine Moll. of N.Z.," p. 64.
Wanganui; Petane.

200. *Hemimactra elongata*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 518, pl. 83, f. 1, 2; *M. inflata*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 18.
Petane. Found also in the Pareora system.

201. *Hemimactra ovata*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 251; *M. rudis*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 19.
Wanganui; Shakespeare Cliff; Patea; Kaimatera.

202. *Hemimactra crassa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 322.
Wanganui.

203. *Lutraria solida*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 19.
Wanganui; Petane; Matapiro. Found also in the Pareora system.

204. *Cæcella neozelanica*, Deshayes, "Pro. Zool. Soc.," 1854, p. 335; *Darina pusilla*, Hutton, "Cat. Marine Moll. of N.Z.," p. 64.
Patea; Matapiro. Found also in the Pareora system.

205. *Zenatia acinaces*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 545, pl. 83, f. 5, 6.
Wanganui; Shakespeare Cliff; Patea; Petane. Found also in the Pareora system.

206. *Paphia neozelanica*, Chemnitz (*Mya*), "Conch. Cab.," vol. vi., f. 19, 20.
Wanganui; Shakespeare Cliff; Petane; Matapiro; Kaimatera. Found also in the Pareora system.

207. *Paphia ventricosa*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 252.
Kaimatera.

208. *Paphia spissa*, Reeve, "Conch. Icon.," *Mesodesma*, f. 18.
Wanganui; Kaimatera.

209. *Psammobia stangeri*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 253.
Wanganui; Petane; Matapiro. Found also in the Pareora system.

210. *Psammobia lineolata*, Gray, in "Yate's N.Z.," p. 309.
Wanganui; Patea; Matapiro. Found also in the Pareora system.

211. *Hiatula incerta*, Reeve, "Conch. Icon.," *Soletellina*, f. 13.
Matapiro. Found also in the Pareora system.

212. *Tellina alba*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 500, pl. 81, f. 1–3.
Wanganui. Found also in the Pareora system.

213. *Tellina glabrella*, Deshayes, "Pro. Zool. Soc.," 1854, p. 366.
Wanganui; Shakespeare Cliff; Kaimatera.

214. *Tellina disculus*, Deshayes, "Pro. Zool. Soc.," 1854, p. 360.
Wanganui; Shakespeare Cliff; Petane; Matapiro.

215. *Tellina subovata*, Sowerby, in "Conch. Icon.," f. 166.
Wanganui; Petane.

216. *Tellina angulata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 322.
Wanganui.

217. *Tellina retiaria*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 322.
Shakespeare Cliff.

218. *Venus oblonga*, Hanley, in Wood's "Index Test.," Supp.
Wanganui; Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

219. *Venus yatei*, Gray, in "Yate's N.Z.," p. .
Wanganui; Petane; Matapiro.

220. *Venus stutchburyi*, Gray, in Wood's "Index Test." Supp.
Wanganui; Petane; Matapiro; Kaimatera. Found also in the Pareora system.

221. *Venus meridionalis*, Sowb., in Darwin's "Geol. Obs. on S. America," p. 250, pl. 2, f. 13; *V. vellicata*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 21.
Petane; Found also in the Pareora system.

222. *Venus mesodesma*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 532, pl. 84, f. 17, 18.
Wanganui; Shakespeare Cliff; Patea; Matapiro; Kaimatera. Found also in the Pareora system.

223. *Venus sulcata*, Hutton, "Trans. N.Z. Inst.," vol. vii., p. 458, and fig.
Shakespeare Cliff; Matapiro. Found also in the Pareora system. Probably a large variety of the last species.

224. *Venus gibbosa*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 21.
Wanganui; Shakespeare Cliff. Probably another variety of *V. mesodesma*.

225. *Cytherea assimilis*, Hutton, (*Chione*), "Cat. Tertiary Moll. of N.Z.," p. 21.
Wanganui; Shakespeare Cliff. Found also in the Pareora system.

226. *Cytherea multistriata*, Sowb., "Thes. Conch.," vol. i., p. 628, pl. 36, f. 177.
Wanganui; Shakespeare Cliff; Petane. Found also in the Pareora system.

227. *Dosinia australis*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 249.
Shakespeare Cliff; Patea; Matapiro.

228. *Dosinia subrosea*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 249.
Wanganui; Shakespeare Cliff; Patea; Matapiro. Found also in the Pareora system.

229. *Dosinia grayi*, Zittel, "Reise der *Novara*," Palæ., p. 45, taf. xv., f. 11.
Wanganui; Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

230. *Dosinia limbata*, Gould, "Pro. Bost. Soc. Nat. Hist.," vol. iii., p. 277.
Wanganui; Shakespeare Cliff. Found also in the Pareora system.

231. *Tapes intermedia*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 526, pl. 84, f. 9, 10.
Wanganui; Petane; Matapiro. Found also in the Pareora system.

232. *Cardium striatulum*, Sowerby, "Pro. Zool. Soc.," 1840.
Wanganui; Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

233. *Chamostræa albida*, Lamarck, "Anim. sans Vert.," 2nd ed., vol. vi., p. 585.
Shakespeare Cliff. Found also in the Pareora system.

234. *Lucina dentata*, Wood, "Gen. Conch.," p. 195, pl. 46, f. 7.
Wanganui; Shakespeare Cliff; Patea; Petane; Matapiro. Found also in the Pareora system.

235. *Loripes concinna*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 323.
Shakespeare Cliff; Petane. Found also in the Pareora system.

236. *Mysia ampla*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 323.
Wanganui.

237. *Mysia neozelanica*, Gray, in "Dieffenbach's N.Z.," vol. ii. p. 256.
Wanganui; Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

238. *Mysia globularis*, Lamarck, "Anim. sans Vert.," 2nd ed., vol. vi., p. 231.
Wanganui.

239. *Kellia robusta*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 323.
Petane.

240. *Kellia effossa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 323.
Petane.

241. *Cardita australis*, Lamarck, "Anim. sans Vert.," 2nd ed., vol. vi., p. 383.
Wanganui; Shakespeare Cliff; Petane; Matapiro; Kaimatera. Found also in the Pareora system.

242. *Cardita difficilis*, Deshayes, "Pro. Zool. Soc.," 1852, p. 103, pl. 17, f. 16, 17; *V. intermedia*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 24.
Wanganui; Petane; Matapiro. Found also in the Pareora system.

243. *Cardita patagonica*, Sowb., in Darwin's "Geol. Obs. in S. America," p. 251, pl. 2, f. 17; *V. intermedia* var. *B.*, Hutton, "Cat. Tert. Moll. of N.Z.," p. 24.
Petane; Matapiro. Found also in the Pareora system.

244. *Mytilicardia tasmanica*, Ten.-Woods, "Pro. Roy. Soc. Tasmania," 1875, p. 161.
Shakespeare Cliff; Kaimatera.

245. *Mytilicardia trigonopsis*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 324.
Wanganui; Petane.

246. *Nucula nitidula*, Adams, "Pro. Zool. Soc.," 1856, p. 51.
Wanganui; Shakespeare Cliff; Petane; Kaimatera.

247. *Leda concinna*, Adams, "Pro. Zool. Soc.," 1856, p. 48.
Wanganui.

248. *Leda fastidiosa*, Adams, "Pro. Zool. Soc.," 1856, p. 49; *L. semiteres*, Hutton, "Trans. N.Z. Inst.," vol. ix., p. 598.
Petane. Found also in the Pareora system.

249. *Solenella australis*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 471, pl. 78, f. 5–10; *Nucula ornata*, Sowb., in Darwin's "Geol. Obs. in S. America," p. 251, pl. 2, f. 19.
Petane. Found also in the Pareora system.

250. *Arca decussata*, Sowerby, "Pro. Zool. Soc.," 1833, p. 18.
Wanganui; Shakespeare Cliff; Petane; Kaimatera. Found also in the Pareora system.

251. *Macrodon* (*Scaphula*?) *lanceolata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 332.
Petane.

252. *Cucullæa attenuata* (?), Hutton, "Cat. Tertiary Moll. of N.Z.," p. 28.
Patea. Found also in the Pareora system.

253. *Pectunculus laticostatus*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 466, pl. 77, f. 4–6, and 1, 2.
Wanganui; Shakespeare Cliff; Patea; Petane; Matapiro. Found also in the Pareora system.

254. *Pectunculus striatularis*, Lamarck, "Anim. sans Vert.," 2nd ed., vol. vi., p. 493.
Wanganui; Petane; Matapiro.

255. *Mytilus magellanicus*, Lamarck, "Anim. sans Vert.," 2nd ed., vol. vii., p. 37.
Wanganui; Shakespeare Clift; Petane. Found also in the Pareora system.

256. *Mytilus latus*, Chemnitz, "Conch. Cab.," vol. viii., f. 747.
Shakespeare Cliff; Petane; Matapiro.

257. *Modiola australis*, Gray, in "King's Voyage," vol. ii., p. 477.
Wanganui; Shakespeare Cliff; Matapiro. Found also in the Pareora system.

258. *Crenella impacta*, Hermann; Reeve, "Conch. Icon.," *Modiola*, f. 64.
Shakespeare Cliff; Petane.

259. *Lithodomus striatus*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 26.
Shakespeare Cliff. A single specimen, collected by Mr. Buchanan.

260. *Perna*, sp. ind.
Petane; Matapiro. Found also in the Pareora system at Castle Point.

261. *Pinna neozelanica*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 259.
Wanganui; Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

262. *Lima crassa*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 33; *L. zealandica*, Sowb., "Pro. Zool. Soc.," 1876, p. 754.
Wanganui; Shakespeare Cliff; Kaimatera. Found also in the Pareora system.

263. *Lima angulata*, Sowb., "Thes. Conch.;" Reeve, "Conch. Icon.," f. 13.
Wanganui; Shakespeare Cliff.

264. *Lima bullata*, Born.; Sowb., "Thes. Conch.," vol. i., p. 22, f. 33.
Shakespeare Cliff; Petane.

265. *Pecten semiplicatus*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 30.
Napier. Found also in the Pareora system at Castle Point.

266. *Pecten laticostatus*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 250.
Wanganui; Shakespeare Cliff; Petane.

267. *Pecten neozelanicus*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 260.
Wanganui; Shakespeare Cliff; Petane; Matapiro; Kaimatera. Found also in the Pareora system.

268. *Pecten triphooki* (?), Zittel, "Reise der *Novara*," Palæ., p. 52, pl. xi., f. 4.
Moteo, near Puketapu. Found also in the Pareora system.

269. *Pecten radiatus*, Hutton, "Cat. Marine Moll. of N.Z.," p. 82.
Wanganui; Shakespeare Cliff; Petane. Perhaps a variety of the last.

270. *Pecten convexus*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 443, pl. 76, f. 1–3.
Wanganui; Shakespeare Cliff; Petane, Matapiro. Found in the Pareora system at Castle Point.

271. *Anomia alectus*, Gray, "Pro. Zool. Soc.," 1849, p. 117.
Wanganui; Shakespeare Cliff; Petane. Found also in the Pareora system.

272. *Anomia undata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 324.
Petane. Found also in the Pareora system.

273. *Anomia stowei*, Hutton, "Cat. Marine Moll. of N.Z.," p. 83.
Petane; Matapiro.

274. *Ostrea edulis*, Linné.
Wanganui; Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

275. *Ostrea corrugata*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 35.
Shakespeare Cliff. A single specimen, collected by Mr. Buchanan.

BRACHIOPODA.

276. *Waldheimia lenticularis*, Deshayes, "Mag. Zool.," 1841, t. 41.
Wanganui. Found also in the Pareora system.

277. *Waldheimia ovalis*, Hutton, "Trans. N.Z. Inst.," vol. xviii.
Shakespeare Cliff; Napier. Found also in the Pareora system at Castle Point.

278. *Terebratella cruenta*, Dillwyn; Reeve, "Conch. Icon.," f. 20.
Shakespeare Cliff.

279. *Terebratella rubicunda*, Solander; Reeve, "Conch. Icon.," f. 27.
Shakespeare Cliff; Petane; Kaimatera. Found also in the Pareora system.

280. *Rhynchonella nigricans*, Sowb., "Thes. Conch.," vol. i., p. 342.
Wanganui; Shakespeare Cliff; Petane; Kaimatera. Found also in the Pareora system.

Art. LVIII.—*On the Age of the Napier Limestones.*

By A. McKay.

[*Read before the Wellington Philosophical Society, 21st October*, 1885.]

The late Dr. von Hochstetter, basing his expressed opinion upon material supplied him by Mr. Triphook and others, referred all the beds in Scinde Island to the upper part of his Hawke's Bay series.

This Hawke's Bay series of Hochstetter is by him referred to the upper division of tertiary deposits in New Zealand, as determined by him, and called "younger tertiary formations." These embrace a triple series: the Awatere series; the Hawke's Bay series; and the Wanganui series. How these are related to each other we are not distinctly told; but it is evident that the terms are not geographical distinctions for equivalent formations in different districts, and that the Hawke's Bay series was considered intermediate in age between the Awatere and Wanganui series.

In the Geological Reports for the year 1868–69, Captain Hutton recognises the existence of the "Hawke's Bay series," and refers to it the beds forming the Mahia Peninsula, and a large district N.E. and S.W. of Poverty Bay. Dr. von Hochstetter had previously referred the beds forming Mahia Peninsula to the Hawke's Bay series, so that there is no doubt that Captain Hutton meant the Hawke's Bay series of Hochstetter. His estimate on the age of these beds is expressed elsewhere, in a paper on "The Artesian Wells near Napier," in which he describes the rocks forming Scinde Island as belonging to a formation "of late tertiary date."

Dr. Hector, in the "Geological Reports" for 1870–71, describing the geology of the Hawke's Bay District, makes use of the term "Hawke's Bay series" for the same rocks as those described by Hochstetter, and quotes from Hochstetter to show that the beds belong to the "latest tertiary formation." Dr. Hector traced the beds north and north-west from Petane to Pohui, and as outliers, further north, beyond the Mohaka River. He referred the Te Aute limestone to the Hawke's Bay series. This had been done by Captain Hutton on the 12th September, 1870.

Thus, to the middle of 1871, there appears to have been no question as to the "late tertiary age" of the Hawke's Bay series, nor as to the conformable relations of all the beds ascribed to it. Next year (5th November, 1872) was published Captain Hutton's "Synopsis of the Younger Formations of New Zealand." and of this, the "Hawke's Bay group" was referred to the oligocene period. This Hawke's Bay group is typically represented by the same locality as that of the "Hawke's Bay series" of Hochstetter, viz., "Napier," but other and distant localities are added, and rock formations of a class and age never contemplated by Hochstetter. The result of this inclusion of strata older than the Awatere series of Hochstetter, was to lower the percentage of recent species found fossil in the beds to 20 per cent.; and, as a consequence, the reference of the Hawke's Bay group to a much earlier period than the Hawke's Bay series had been referred to. How far the two should be considered identical may be inferred, and remains to be seen.

In 1873, Captain Hutton suppressed the name "Hawke's Bay group," and substituted "Ahuriri formation" in its place, and, describing its fossils, considered that 23 per cent. of its mollusca and echinodermata were recent species. The Hawke's Bay group or Ahuriri formation was now referred to the lower miocene period.

In June, 1875, the same beds were, by Captain Hutton, referred to the middle miocene period.

On the 4th of January, 1875, I divided the tertiary strata of Hawke's Bay District into Lower or Hawke's Bay series, and Upper or Wanganui series, including the shelly limestones of Napier with the lower group or series. During the early part of 1876, Mr. Cox examined the country between Poverty Bay and Napier, and determined the tertiary rocks of the district as a single sequence, to which, however, he assigned no particular period, eocene or pliocene. He considered the Napier limestone to be near the base of the series, although his statements are somewhat incompatible with the assumed conformity of the whole series of tertiary beds described by him. Dr. Hector at the time considered the higher beds described by Mr. Cox as belonging to the same horizon as the Upper Wanganui beds.

During November of the same year, Mr. S. Percy Smith read before the Auckland Institute a paper on the "Geology of the Northern portion of Hawke's Bay," and, like Mr. Cox, describes an upper and a lower limestone, separated by a great thickness of sands, clays, and conglomerates; all presumably of tertiary date.

In 1873, Captain Hutton rejected, as not belonging to the Ahuriri formation, the conglomerate sands and clays in the Cape Kidnappers section, which are described by Hochstetter as the base of the Hawke's Bay series, the higher beds appearing at Scinde Island and at Petane. These beds were considered by Dr. Hector, when he examined the district in 1871, as occupying the position assigned them by Hochstetter. Captain Hutton considered them pleistocene, and later I spoke of them as belonging to the Wanganui series. The position of similar rocks, described by Mr. Cox and Mr. Percy Smith as underlying the limestones of Scinde Island and the coast to the northward, and the reference of these with the overlying shelly limestones, seemed to call for a revision of the Ahuriri series of Hutton. Other causes, however, brought this about at an earlier date than the publication ot Mr. Cox's report, which did not appear till 1877.

In a paper read before the Otago Institute on the 24th of October, 1876, Captain Hutton discusses the relation between the Pareora and Ahuriri formations; in which, referring to the classification of the tertiary formations of New Zealand in his "Catalogue of the Tertiary Mollusca and Echinodermata," speaking of the beds separated and grouped under one or other of these formations, he says: "I have been gradually led to doubt the correctness of this division, and to consider it probable that both ought to be regarded as one and the same formation." He now gives the proportion of recent species found in the Ahuriri formation as being 35 per cent., or, with the same number of species, 12 per cent. more than in 1873.

Early in 1877 I examined the country between Masterton and Napier; and in reporting on the geology of this district, I divided the tertiary rocks as I had previously done in 1875, referring the beds overlying the Te Aute limestone to the pliocene period, and the limestones W. and N.W. of the Ahuriri Plain, and in Scinde Island, to the upper part of this higher series; and later, in August, 1878, I pointed out that these were unconformable to the Te Aute limestones. This had already been indicated by Dr. Hector as their probable relation, in his Progress Report for 1876–77.

On the 14th of January, 1885, there was read before the Geological Society of London "A Sketch of the Geology of New Zealand," by Captain Hutton. In this the author states that the grouping of the tertiary rocks is founded on that given in a former

communication to that Society, which was the same as the synopsis of the younger formations of New Zealand, published in the "Reports of the Geological Survey" for the year 1871–72. Captain Hutton, however, adds that the new classification includes modifications subsequently made. These, however, cannot affect the chronological arrangement of the different series or groups of strata, without at once destroying all semblance which the latter might have to the former classification; and we are compelled to take the different series included under the Pareora system as a chronological arrangement, and in the order in which they are stated. Those series, in descending order, are:—

1. Awatere series.
2. Kanieri series.
3. Tawhiti series.
4. Ahuriri series.
5. Waitemata series; and
6. The brown coals of the Pomahaka, etc.

The Awatere and Kanieri series, or groups, formerly constituted the Pareora formation, the Ahuriri formation being the next underlying. Now, however, we have between these the Tawhiti series; and it is manifest that Captain Hutton has abandoned the idea that the Ahuriri and Pareora formations are the same. If it is otherwise, he makes no distinction (stratigraphical or palæontological) between the Scinde Island limestones and the rocks forming the Taipos, on the east coast of Wellington, or the brown coal beds of the Pomahaka, in Otago; all the divisions being referred, not to the relative parts of a system of rock-formations, but to a single series, having strict equivalents in all the localities where rocks belonging to the Pareora system are present.

On the 2nd July last, Captain Hutton read, before the Philosophical Institute of Canterbury, a paper on the "Geology of Scinde Island," in which, for the first time, he describes the limestones present in Scinde Island, the lower of which he refers to the Ahuriri series of his last classification, and the upper to the Wanganui system and Petane series of the same. He says that the upper limestone, with the accompanying underlying sandy beds, is unconformable to the lower limestones, and shows them highly so in the section which accompanies his paper. It is further said that the lower limestone is the equivalent of the Te Aute limestone, which is also stated to be the equivalent of the Pohui limestone of Te Waka. Of the 24 species of fossil shells collected from the lower or Ahuriri limestone, 15, or 61 per cent., are noted as recent species; and we must remember that the original Hawke's Bay group was supposed to contain no more than 20 per cent. of recent shells.

During the 5th, 6th, and 7th September last I examined Scinde Island, and agree with Captain Hutton that there is an upper and a lower limestone in Scinde Island, but saw no reason to suppose that these were unconformable to each other. To me, the evidence was quite clear that the lower limestones and overlying sands are connected by passage beds, and shade into one another. I further found that, not the northern, but the western side of Scinde Island showed the presence of the younger series; and I could not arrive at the conclusion that the lower beds are the equivalents of the Te Aute limestone, nor of any formation containing no more than 35 per cent. of recent species. The upper beds, I admit, resemble the shell limestones of the mainland to the W. and N.W. of the Ahuriri Plain, but I was forced to the conclusion that either the upper limestones are not the same as those on the mainland already mentioned, or that the lower limestone was not the Te Aute limestone, and in all these conclusions differ from the opinions of Captain Hutton.

To try to solve the various problems thus requiring to be considered, I went to Petane, and thence by coach to the Mohaka Valley, spending two days to the west and north of the river-crossing, and the other available day on the Te Waka Range; the sequence to the eastward I but partly observed. I traced the tertiary sequence, as here represented, to its base in the Kiwi Range, and further to the north along the Taupo Road. I found strata rich in fossils in this direction, on the north-western side of this part of the Mohaka Valley, and was able thus to refer nearly a thousand feet of strata to the Pareora series of the Geological Survey classification.

The fossils of this part of the tertiary sequence are abundant in the Mohaka river-bed, near the bridge and crossing of the Taupo Road; but I did not content myself with these, but sought out the fossiliferous beds in section.

These lower beds are characteristic, and not difficult to be distinguished from those that over-lie on the south-east side of the valley. They are brown, green, or grey sands, or fine grit, with concretions or beds of harder and more calcareous material full of shells. In their upper part, the brown sands alternate with lighter-coloured sandy clays. They dip a little to the S. of E. at moderate angles, 20° to 25°. Eastward of the Mohaka these are followed conformably by a great thickness, more than 1,000 feet, of light-grey sandy beds of a more argillaceous type than the last brown sand bed appearing in the Mohaka east bank, at the crossing. This series is closed by a bed of brown sand of considerable thickness, which shows on the western brow of the Titiokura saddle, by which the Napier-Taupo Road reaches the Mohaka. These appear to be the gritty sandstones, "No. 9," of Mr. Percy Smith's map, and the "grey and brown sandstones" of Captain Hutton. Fossils are rare, and I collected

none; but Captain Hutton mentions four species occurring in them, only one of which, *Struthiolaria tuberculata*, I found in the lower beds. I would refer these rocks to the Awatere series of the Geological Survey. They are conformably overlaid by the Pohui limestone. This is a thick band of coarse, shelly limestone, often loose calcareous sand, with harder bands at irregular distances, and not continuous, at least where the Taupo Road crosses it. Further to the S.W., on the Te Waka Range, it is perhaps 100 feet thick; and further to the S.W. appears to be much thicker. It abounds with fossil shells in the lower part; and in the upper part, not far from the Taupo Road, it is full of small corals. Further to the S.W., and S.E. of its disappearance on the road-line before reaching Pohui, this lower limestone is followed by argillaceous sands of about the same thickness as those seen between the two limestones in Scinde Island, and these are followed by a second limestone, as in Scinde Island. It is this upper limestone that forms the peculiar cubical, castellated feature of Te Waka itself, the inferior limestone forming the western scarp of the range, and separated from the upper as already stated.

The lower limestone, however, shows in the scarp, running nearly N. and S. at the back of Pohui, and finally disappears at Pohui Lake. The upper limestone, yet separated by the argillaceous sands spoken of, disappears half a mile to the S.E. at the first bridge on the road to Napier. This represents the section in Scinde Island; that is, the succession and character of the rocks are the same. The fossils have yet to be exhaustively collected before this can be finally determined.

The fossils I obtained are chiefly the larger *Pectens* found in the lower limestone in Scinde Island. They were specially sought for, as I was under the impression these would determine the age of the beds; but *Voluta pacifica*, *Pinna neozealanica*, *Pecten radiatus*, *Modiola areolata*, and *Waldheimia lenticularis*, were also collected, shells yet living, and not found lower than the limestone in Scinde Island. It further seemed to me that had an exhaustive collection been made, it would have been characterised by a very large percentage of recent species. It would, however, be unfair to add these recent species as occurring in the lower of the Scinde Island beds, and thus raise yet higher the percentage of recent species found in that limestone. This is already sufficiently high; but there seems some reason to suppose that, contrary to what Captain Hutton says is probable, further research will add to and not diminish this percentage; and I believe that two of the species mentioned do occur in the lower beds in Scinde Island.

I have not time, nor is it my present purpose, to discuss the probabilities of an unconformity in this line of section east of Pohui. I could not determine any such to be present. I

observed that the next rocks seen on the road-line, to the S.E. of the disappearance of the Upper Pohui limestone, were light grey sandy beds, very much resembling those seen to the N.W. of the Lower Pohui limestone on the fall from the Saddle into the Mohaka Valley, and these might be brought into this position by a fault or unconformity; but, were this so, the overlying brown sands and conglomerate would yet have to show evidence of unconformity, and I could discover none.

Further to the E. and S.E. the section has already been described by previous observers, and I need not here detail it.

Grey and brown sands and coarse sandstone conglomerates, pupa rock, and tufaceous sands, form a great series of strata before reaching the overlying shelly-limestones of Petane and the coast range to the N.E. of the Lower Esk. Between Pohui Lake and the coast there may be 2,000, 3,000, or even 4,000 feet of strata; its exact measure is not at present of importance, it being admitted on all hands that collectively there is a great thickness of strata, amounting to some thousands of feet. This, in some way, we have to consider represented in Scinde Island, and by not more than some 120 to 150 feet of strata. This is possible, but, considering the distance between the Esk Valley and Napier, barely probable.

Next we have to consider that the section from Puketapu, on the Tutaekuri River, back to the S.W. continuation of the Pohui limestone, shows no diminished thickness of the beds overlying the latter and underlying the Petane limestone, rendering it yet less probable that this great series can be represented a few miles off by so small a thickness as that of their supposed representatives in Scinde Island. Farther to the S.W., along the Ngaruroro River, from the limestone hills on the western border of the Ahuriri Plain to the lower end of the Ngaruroro Gorge, a yet greater thickness of these beds is developed; and let any one look from the offing in Hawke's Bay at the immense development of conglomerates, sands, and clays, that between Cape Kidnappers and the mouth of the Tukituki are present, and then consider that these must be fully represented in Scinde Island—if we are to regard the upper shelly limestones there the same as that found on the mainland at Petane; or, as an alternative, the lower limestones the same as the Te Aute limestone. And, in spite of liberal allowance in the way of thickening and thinning of the strata, the reasonable probabilities of the case will be, with most observers, that either the Petane limestones are not present, or, that the Te Aute limestones are absent. There is, however, a third possibility: but this has never yet suggested itself to any observer of the geology of the district, and I dare say will not now be entertained. This is: there may be a double unconformity in Scinde Island. Firstly, between the lower or supposed Te Aute limestones of Hutton; and, secondly,

between the Petane sands and the overlying shelly limestones, thus admitting of the reduction by denudation of the intervening beds down to the meagre thickness which they now present.

What may be the final conclusions respecting this stratigraphical difficulty I am not prepared to hazard an opinion. Meanwhile, I do not consider the upper miocene Te Aute limestone present in Scinde Island. The palæontological evidence brought forward by Captain Hutton is against this, and the evidence, as collections are added to, is likely to be strengthened rather than weakened; that is, if the Pohui limestone be the same as the lower limestone in Scinde Island, which it is asserted to be.

One difficulty in the way of regarding these rocks as of pliocene age has been the number and remarkable size of the extinct forms of *Pecten* found in them, which are not supposed to occur in the upper shelly limestones of admittedly pliocene age, and which occur also abundantly in the Te Aute limestone. This is by no means an insuperable difficulty, and we have only to consider them as exceptional, and in reality belonging to an older period. Looked at in that light, they would have to be excluded in arriving at the age of the beds, as determined by the percentage of living species; and were this done, all doubt of the pliocene age of the beds would be removed. There would then be 71 per cent. of recent species found in the beds. Were these *Pectens* retained, and the five recent species found at Pohui added to the 15 occurring in Scinde Island, we should have a like result—viz., nearly 70 per cent. of recent species from the limestones of this horizon.

From the Lower Wairarapa Valley, N.E., to the northern part of Hawke's Bay Provincial District, the Te Aute limestones everywhere close the middle tertiary sequence, as seen in this part of the North Island. The Pareora formation of Hutton, characterised by a proportion of recent species equal to 37 per cent., should, one would think, underlie the Te Aute limestones, at least ought to underlie its supposed representative in Scinde Island, with 61 or 70 per cent. of its species recent. And yet, if we accept Captain Hutton's latest classification, we are required to suppose that the Pareora beds, containing little more than half the number of living species, are actually the older series. The Te Aute limestone cannot be made to occupy this position relative to the Pareora series, without setting aside all the evidence obtainable, both palæontological and stratigraphical; but if regarded as the highest member of that series, this would be more in accord with what is known as to its actual position. It may be the lowest member of the young tertiary sequence; more probably, along the East Coast of the North Island it closes the middle tertiary series.

V.—ASTRONOMY.

Art. LIX.—*The Total Eclipse of the Sun of the 9th September, 1885; being a Digest of the following Communications to the Institute on the subject:—*

A.—On the Total Eclipse of the Sun, 9th September, 1885. By John Meeson, B.A. Read before the Nelson Philosophical Society, 2nd November, 1885.

B.—On the Total Eclipse of the Sun, 9th, September 1885. By the Right Rev. Dr. Suter, Bishop of Nelson. Read before the Nelson Philosophical Society, 2nd November, 1885.

C.—On the Total Eclipse of 9th September, 1885, as seen at Tahoraite. By John Goodall, M.I.C.E. Read before the Hawke's Bay Philosophical Institute, 14th September, 1885.

D.—On the Total Eclipse of the Sun, 9th September, 1885. By A. S. Atkinson. Read before the Nelson Philosophical Society, 2nd November, 1885.

E.—On the Total Eclipse of the Sun, 9th September, 1885. By Dr. Hudson. Read before the Nelson Philosophical Society, 2nd November, 1885.

F.—Observations on the Solar Eclipse of 9th September, 1885. By A. Coleman. Read before the Nelson Philosophical Society, 2nd November, 1885.

Plates XIV., XV., XVI.

[Note by the Editor.—The section of the moon's shadow, as it swept over the earth's surface, was in the shape of an ellipse, 190 miles in length by 90 miles in width. The only land crossed by the shadow was that part of New Zealand lying in the vicinity of Cook Strait, so that the total phases could only be observed there; the line of centrality sweeping in the shape of a curve from a point half-way between Australia and New Zealand, where the sun was rising at the time of totality, to a point between Cape Horn and the South Pole, latitude 75° S., where the sun was setting at

the time of the eclipse. In New Zealand, the line of centrality passed through West Wanganui, Collingwood, D'Urville Island, and the Wairarapa, leaving the land on the East Coast at Castle Point. At all places along the line of centrality, the duration of the total phase was computed at 1′ 58″, the time being a few seconds longer towards the east. At Castle Point, the totality commenced at 7h. 35m. 12s. a.m., New Zealand mean time; at Wellington, at 7h. 35m. 4s.; and at Nelson, at 7h. 34m. 14s. Observations of a more or less scientific nature were taken at a number of places—Tahoraite, Wairarapa, Manawatu, Wellington, Picton, Nelson, Collingwood, etc.; and a large number of papers and communications were made to the public press, and to various scientific societies, conveying the impressions of the various observers.

From a review of the observations that were made, the following conclusions were arrived at:—

"Scarlet prominences were only moderately developed, and were clustered chiefly at the equatorial and polar regions of the sun. The best observers agree that the corona had a very irregular outline, and was most continuous and vivid close to the sun's limb, having the longest expansion reaching to nearly two diameters from the western equatorial region. This large expansion appears to have had a strongly marked spirally twisted structure, while all the other appendages consisted of radiating pyramids. No laminated structures appear to have been observed in any part of the corona.

"Most observers agree in describing an intensely brilliant flash or meteor, lasting for two seconds, at the commencement of totality on the eastern side of the sun, and exactly over the position of a large sun-spot that was just coming into view at a few degrees south of the sun's equator. This flash is described as having looked like a large electric lamp suspended at a little distance from the moon's edge. At the close of totality another flash, similarly bright, but not so large and pointed, was seen on the western limb of the sun, in a position corresponding with a large sun-spot that was within 1′ of arc of passing over the sun's edge."*]

I.—General Description.

Mr. John Meeson, B.A., gives the following general description of the eclipse:—

"The weather was perfect, the sky almost, if not quite, cloudless, with a very light wind from the S.E.; a clear, moistureless, frosty air! My point of observation was my own garden at Woodstock, Stoke, whence, from 6.45 a.m., when the

* "Proc. Roy. Soc., London," 19th November, 1885, "On the Total Solar Eclipse of September 9," by Dr. Hector, F.R.S., dated 12th September, 1885.

sun—already partially obscured—rose from behind the north-eastern hills, until 8.30 a.m., by which time the moon had completely passed over the solar face, the view was continuous and uninterrupted. More perfect circumstances for making valuable observations cannot well be imagined; and a sight grander and more unique than the whole eclipse it is impossible to conceive. Even as the wind falls when the shades of evening close around, the very light breeze which had been blowing in the early morning gradually died away, and darkness increased. Birds ceased their twittering, all—at all events, except some paraquets, which were evidently much startled, and broke into the most noisy chattering as the sun disappeared, and flew away, it may be supposed, to their usual night haunts. Everything else became hushed; even the human voice had, or seemed to have, an unnatural sound. All nature seemed to bow its head, and stand in mute silence as the awful spectacle passed, and until the God of Day should again emerge from his temporary seclusion. The general appearance of things at the moment of totality, which was certainly not a period of complete darkness—for a soft and 'dim, religious light' was always present—was such as the observer can surely never forget. It was decidedly uncanny. The human face looked ghastly. The colours on mountain and field, on sea and sky, were weird, unearthly, and indescribable, such as one had never seen before. They had gradually deepened in hue as the eclipse proceeded, and just before totality the sky around the sun was of a dirty yellow, and quivering beams, of the colour of electric light, shot out from above and below the moon, giving it somewhat the appearance of a St. Andrew's cross with a circular centre.

"Generally speaking, during the sun's complete obscuration, the sky was of a mauve colour, except round about the luminary itself, where the intense brilliance of the silvery protuberances or the golden glory of the coronal rays diffused tints of dirty red and grey. The sea became black, the mountains across the bay iron-grey, while the sky above the latter assumed shades of dirty, ghastly yellow. A few patches of fleecy clouds hanging low over the sea took on the appearance of black cumulus heaps, and afterwards, on the emergence of the sun, donned garbs of varied colours. The lunar orb, during totality, stood out boldly, and round its limbs was a fine fringe of intense light, which glistened like diamonds; upon its surface a slight reflected light was clearly seen. After the eventful period of a minute and a few seconds had passed, there appeared, at the point of the moon's disc opposite to that which first obscured the sun—at the point, that is, where arose, as we shall afterwards see, the longest streamers of the corona and the highest prominences,—a growing effulgence of light, which rapidly intensified as we watched. The prominence seemed to swell and

bubble and boil like a spring of molten silver. This appearance was produced by the blending together of the large prominences and the sun's reappearing disc; and not for several seconds, perhaps, did the latter assert itself, assume its true shape, and, by its superior luminosity, cast the protuberance into obscurity, and substitute its ordinary beams for the temporary or temporarily-perceptible coronal rays. During the obscuration, stars were plainly seen by those whose attention was not already bespoken by something more unusual. I saw Jupiter very distinctly. The rushing of wind, as from all points of the compass, remarked upon by one of our local newspapers, I certainly did not experience. The fall of temperature along the belt of totality, instead of causing wind thitherwards, would rather operate to produce motion of the air in precisely the opposite direction. But, as already observed, there was really no wind at all, but over everything the stillness as of death."

The Bishop of Nelson describes the eclipse as observed from a hill near Nelson:—

"The *sensible* progress of the eclipse at first seemed slow, but at the critical and crucial moment it appeared cruelly rapid. The body of the moon crept on over the left or western limb of the sun, and while it was about half over, there was a very sensible diminution in the light. It began to be a cold and silvery light, and the absence of yellow light seemed more and more marked, till the not unfamiliar lunar crescent-shape was assumed by the sun; and this stage was the period of quite a peculiar phenomenon in the appearance of the hills below the sun. Each one of the many rough furrows of valleys, divided by ridges of bush, became dark and black in shade; but each ridge was distinctly marked by a yellowish-green light, so remarkable as to form the subject of notice by me to the bystanders, who all acquiesced in the recognition of the decided and noticeable peculiarity of the appearance. It was most marked, and fortunately so much so as to be capable of reproduction. Possibly there may be a somewhat similar appearance under the crescent moon.

"As totality came near, and one's attention was confined almost exclusively to the sun, it seemed to me that the crescent was divided into one or two elongated portions of light, and then, subsequently, that these elongated portions were divided up into what reminded me of the cogs of a wheel, or rather the little blocks of different metal that are planted in the rim of the compensating balance of a good watch or chronometer. I suppose this appearance to be that described as "Bailey's beads." They appeared to me to exist for only a very short time indeed, but they were distinct cogs of light, over little more than a third of the edge of the sun, on the eastern or lower side.

"It then appeared to me as if the sun, or dark body of moon,

were encircled with a brilliant ring at the time when, to use a common phrase, the sun "went out."

"This corona, or ring of light, had time just to print its impression on the eye when *two appearances* made themselves manifest: First, the body of the moon started into rotundity—or, if I may use the word, globosity—from two . . . into three, from being a black disc, into a faintly but decidedly luminous globe, the effect, we are told, of *earthshine* on its surface. Earthshine in its effects is decidedly less evident than moonshine. (The second appearance is dealt with under the heading 'Prominences.')

"The darkness was not exactly that of night. As to the degree of light, it seemed to be paralleled by the amount of light diffused about when the moon is nearly half full; but the light that remained on this occasion was not that of the blue silvery moonlight, but of a neutral character, and the darkness seemed to have a palpability, if so it can be called. At the latter part of totality I turned to pick up the binocular, which I had discarded for the plain smoked glass guard, and was surprised then at the actuality of the darkness. I turned round, and caught sight of what made me look again, and I experienced a sensation to which I can only apply the epithet appalling.

"The glorious sign in the heavens shone forth on a yellowish-grey sky, which shaded off on the distant horizon to brilliant yellow and orange; but in mid-air, to the north-west, rode in the air a bank of clouds, over which the conical shadow was passing. Light was visible on both sides of the band of the total shadow, and all objects within that range and near the darkness seemed to come up quite close to one; distance seemed annihilated. I felt as if this bank of clouds was quite close upon me. It was composed of towering cloud masses, standing out in stereoscopic solidity, blotched (as a painting) with rounded masses of purple, blue-black, and grey, and at the edges having bands of burnt sienna; under the clouds was the bright light I have mentioned."

Mr. John Goodall, M. Inst. C. E., observed the eclipse at Tahoraite, in the Forty-mile Bush. The following extracts are taken from his paper:—

"I went to Tahoraite on the afternoon of the 8th; the weather was not promising; there were repeated showers of rain, hail, and sleet up to two o'clock in the morning, ever, with any great hopes of being able to use it. By 6 a.m. but by five o'clock there was a fine clear frost, and scarcely a cloud in the sky, with every prospect of successful observations of the eclipse. I mounted my telescope, a $4\frac{1}{2}$-inch refractor, and attached a direct vision spectroscope to it—not, how-all was ready, and the telescope pointed to the eastern horizon, which was perfectly clear. Towards the south there was a

heavy bank of clouds rising, looking dangerous enough to mar the event of the day. A stray cloud creeps near to the path of the sun, becomes illuminated, changing colour rapidly, ending with the silver lining, and the sun appears above the dark, ragged line of the tops of the distant New Zealand bush, perfectly clear of clouds; as it rises, three bands of clouds cross its face. This ominous indication soon disappears, and the sun is in its full splendour, revealing to the telescope two large groups of sun spots and faculæ in its eastern and western limbs. A peculiar ruddy tint now appears over the sun, caused probably by cosmic dust or earth vapour. As the sun rises to about 10° this ruddy tint disappears, and we patiently await the first contact of the moon, the first indication of which is a roughening of the sun's edge, and an appearance of dark pellets on the rim at contact. This is soon obscured by the sharp edge of the moon, the circular dent of which, in the sun's face, becomes clear, and the eclipse has fairly started. Gradually the moon creeps in along the path of the sun spots, the march of which becomes obliterated; and when it has obscured the sun by about one-fourth, the visible edge of tne moon is tinged with an orange-yellow tint. This extends to about two minutes of space, and was observable until the sun was more than three-quarters obscured. The changing shape of the sun, as it was gradually obscured by the moon, was particularly interesting; and as it acquired the crescent shape, light began to diminish, and the atmosphere got very cold. The horns of the crescent sun were strongly tinged with deep orange; and when the crescent became very fine, it appeared to me at one time that a portion of it was obscured before the time, which must have been caused by an irregularity in the moon's edge. The eventful moment approaches: there is just a thin strip of the sun now visible, which scintillates like the stars, and the light is like that from the electric arc, of a bluish tint, and all shadows are sharp; there is a weird appearance over everything. . . . Suddenly the shape of the moon begins to show beyond the visible edge on the sun, and soon the whole of the moon is visible—a blacker circle in a black background. Instantly the corona appears as an encircling light, opposite to where the sun yet shines, fully ten seconds before totality; when of a sudden, as if the moon, gradually toiling on, made one last effort, it took one great leap and obliterated the sun, as if for ever; it was, indeed, awe-inspiring, and it is impossible to describe the feeling of the moment. Immediately the sun disappeared, there was a beautiful transformation scene. It appeared as if the sun's place was occupied by a beautiful black jet ornament, set with scarlet points, and fringed with strings of pearls. . . . Twenty minutes after the total eclipse, the sun was obscured by clouds."

II.—The Temperature.

Mr. Meeson says, concerning the temperature:—"To get the variations in temperature during the continuation of the eclipse, I made use of two self-registering thermometers, which I inspected every quarter of an hour. One of these was fixed in its usual place, 6 feet above the ground, well in the shade, and protected from the wind; the other hung on the outside of a conservatory, 2 feet above the ground, and fully exposed to the sun. The following table gives the successive changes which took place:—

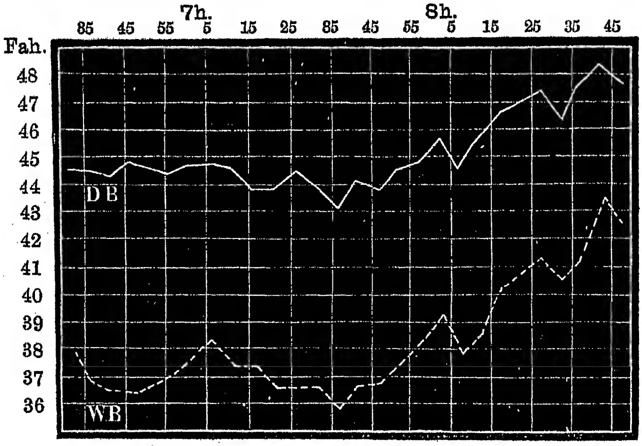
Time	¼ to 7 a.m.	7	7.15′	7.30′	7.45′	8	8.15′	8.30′
Shade temperature	30° F.	32°	34°	35°	33°	31°	32°	37°
Sunshine temperature	30° F.	33°	39°	42°	36°	40°	50°	70°

"From this table it will be seen that my thermometers did not register such a great fall in the temperature as some observers report. In the shade there was a fall of four degrees, sufficient to carry the indicator below freezing point; and in the thermometer exposed to the sun, which more readily responded to the thermal changes, the fall was a clear six degrees. The coldest point of time seems to have been 8 o'clock, and not at the moment of totality—just as the coldest time during night is not at midnight, but two or three hours after, and the hottest part of the day not at noon, but about 2 p.m. If the early morning of 9th September had not been somewhat colder than usual—as a matter of fact the temperature then descended to 28° F.—perhaps the fall during the eclipse would have been more perceptible than it actually was; there was certainly a sudden fall at the moment of totality, for, though it was a minute of much excitement, everybody became sensible of the difference of temperature. The descent, however, recorded by the sunshine thermometer was, as we should have expected, greater and more sudden than that recorded by the instrument in the shade. I am quite prepared to believe that the actual fall during and immediately after totality was, as some observers say, even greater than that which I have recorded; but I find, in confirmation of my figures, that in Wellington the fall recorded was 5½°, and that the loss of temperature there was not recovered till nearly 9 a.m."

The Bishop of Nelson states that the thermometer stood at 38° immediately before sunrise, and that during the eclipse it went down to 31°, the whole ground being covered with hoar-frost immediately after totality. The reduction of temperature was very evident, as also the getting up of a strong south cold wind.

The temperatures observed by Mr. T. W. Kirk, in Wellington, on behalf of the Government Observatory, are embodied

in the accompanying diagram, showing the curves of dry and wet bulb standards, recorded at every five minutes' interval from 6.30 to 8.45 o'clock.



III.—The Prominences.

Mr. Meeson's paper contains the following remarks:—"As to the so-called red protuberances, I saw distinctly prominences, but they, one and all, seemed to me intensely white or pearly in colour—such as those described by Professor Airy in the eclipse of 1851—rather than red.

"Perhaps my sense of colour was temporarily impaired by the unwonted and unearthly hues which prevailed on everything at the time. I could persuade myself, perhaps, that one or two of the smaller prominences, situated on the eastward of D. in the chart, were of a faint rose-colour, but not red. Whatever their colour, and whatever their real nature—mountains, clouds, or flames—they were exceedingly beautiful and wonderful; but, as they can be, and are now, studied at any time when the sun can be seen, whether he be eclipsed or not—or rather, perhaps, as the sun can be by modern astronomical contrivances so artificially eclipsed that the prominences are rendered visible—it is very improbable that any observations of ours as to them can have any scientific value. The differences in our impressions as to the relative size and place of the prominences, arise probably from the fact that our observations were not made precisely at the same second of time. At the commencement of totality the largest prominences visible were those on the lower eastern or right limb; and towards the close they were those on the upper western, or left limb. During the passage of the moon across the sun's face, the prominences near where the sun was last visible diminished in size, while those directly opposite considerably increased. In astronomical books these prominences

are said to be heaps, jets, or flames. Those which we saw were heaps, I think, and they were less serrated and fantastic in shape than some of us perhaps expected. Decidedly the largest prominences, towards the close of the total obscuration, appeared over the moon's left upper limb, at an angle of about 30° from the perpendicular, directly below the point where I observed the longest and most vivid coronal ray. Its apparent height above the limb of the moon could not have been less than 70,000 miles, for it reached to nearly $\frac{1}{12}$th of the moon's apparent or angular diameter, which I take to have been about the same as that of the sun—

Say 2½′ — the sun's being 32′ 36·41″, or 850,000 miles in actual diameter,
the moon's 31′ 26″ ,, ·2,153 ,, ,, ,,

How much this protuberance, or, indeed, any of the others, was foreshortened, of course it is impossible to say. The real height was perhaps in every case considerably above the apparent.

"Of two prominences I wish specially to speak. They do not seem to have been generally observed, but were clearly seen by other members of my household beside myself. One of them was also observed from the Hospital, by Dr. Boor. They were like tiny clouds, of a heapy character, and differed entirely from the other prominences, inasmuch as they were of a dun, or dark-smoke, nearly black colour. Their positions were, one at an angle of about 40° from the perpendicular towards the east, and the other at about 10° below the horizontal line on the lower western limb. Their position and relative size were recorded at the moment of observation. They were entirely different in appearance from the silvery or white, or rose-coloured prominences; and were no optical illusion, for I was so surprised to see them that I looked at them again and again with the binocular or coloured glass, and with the naked eye alternately. While I observed them, they seemed to undergo no change. What were they? Goldschmidt noticed similar little grey clouds in the eclipse of 1860, (Proctor's "Sun," p. 262,) but these were in part isolated, and floated, so to speak, outside the solar limb at some distance, and were also observed subsequently to develope into rose-coloured protuberances. Perhaps ours did the same, but the transformation was not observed by me. Someone says, 'Were they planets?' No; their size and irregularity of shape, apart from other reasons, would prevent us from entertaining that supposition. Were they faculæ projecting above the sun's disc, such as that seen by Mr. Dawes? (Proctor's "Sun," p. 180.) Were they such dark curves as Herr Grosch, of the Santiago Observatory, saw upon the moon's limb, in the total eclipse of 1867; sharp curves, resembling in appearance lines drawn with lead-pencil on white paper? (Proctor's "Sun," p. 346.) Were they mountains in the moon? If they were, lunar heights tower far higher than even those fabulous ones of Captain Lawson in New Guinea.

Professor Balfour Stewart, in one of the Manchester Science Lectures, says that the prominences sometimes assume the appearance of a cloud, instead of a fire or a fiery tree. If so, there need be no further difficulty. Our two little dusky patches have a place among recognized phenomena."

The Bishop of Nelson says:—"The intensification of brightness at certain points in the above mentioned ring of light (*see* General Description above), the chromosphere or ring, amounted to luminous protuberances, which to my eye, and I can only answer for that, had the appearance of molten mountains of liquid silver, increasing with every beating second in intensity of whiteness, combined with the idea also of light or luminousness. Light seemed to flow out of them in liquid streams. It was condensed, not dispersed light; to speak in popular language, it seemed as if it were light coming out in liquid streams: lava streams of silver, ever and anon coming out of the three craters of light. I saw no red flames, though, honestly, I tried to see them; I had one momentary glance of redness, but that was at an earlier stage. . . . It seemed to me as if I witnessed once more what I witnessed in the north of England, at Bolton, in Lancashire, in the pouring out of the cauldron of molten steel in the Bessemer process, in which I believe oxygen plays so important and striking a part."

Mr. A. S. Atkinson states as follows:—"The only 'red prominences' I saw were a row of six or seven small ones, extending from about the vertical point towards the east, looking to the naked eye of about the same size and shape, and at about the same distance apart. Larger ones were seen by others, and, I believe, appear in three places in the photographs. The tallest of these red prominences, measured very roughly on the photograph, seems to be about $\frac{1}{12}$th the diameter of the sun: if really so, it would represent a height of some 70,000 miles, while the long white cone I have mentioned (*see* Corona) was probably not less than 500,000 miles. Mr. J. R. Akersten obtained for me two small photographs during totality: one immediately after it began, with an exposure of something less than a second, the other a few seconds later with about double the exposure. A third plate was in the camera, and all but ready, when the sun reappeared; it was taken just after the reappearance, but two of the red prominences are still shown. It will also be noticed that in this photograph there is a rather well-marked ray, tangential to the reappearing sun, though not to the central point of the bright limb; or, say, not parallel to the line joining the two cusps; indeed, the latter line, if produced to the westward, would almost meet the ray as it is, without the latter being produced at all. There are also two short divergent rays of ordinary sunlight. There are also two short divergent rays from the eastern cusp, and a shorter and fainter one from the western

The tangential ray, measured from end to end through the glare, is apparently equal to two diameters; the longest of the shorter ones to little more than a quarter of a diameter. They are, I presume, rays of ordinary sunlight. If I might hazard a guess as to the cause of those from the cusps, I would ask whether they might not be owing to the irregularities of the moon's limb at those points, similar rays elsewhere along the limb being lost in the glare? It will also be seen that there is apparently a well marked halo round the emerging sun, which shows very strongly in the unenlarged original views. Whether this is merely the work of the camera, or is connected with the 'sun-cloud' now always surrounding the sun, or what else the cause may be, I am quite unable to say. I certainly did not see any such halo, but then I was closely watching the sun myself." (For a very similar halo in a photograph of the full moon, see "Nature," vol. xxi., p. 33.)

Mr. Goodall says: "While I was sketching, a flame seemed to burst out of the side of the moon in the opposite direction to where the sun was last observed, remain unaltered for a few seconds, then the corona gradually faded, and a flood of light was shed all round, and the grandest sight I ever witnessed came to an end. The scarlet setting, or the prominences, were very plainly visible through the telescope."

Dr. Hudson states: "Of prominences I saw two, marked *a*, and I thought I saw a flat low one in the position marked *v*. I did not see the prominence marked *c*, which, as it has been so universally observed, must have been a distinct and real one. The prominences appeared like burnished silver, with a slight coppery tinge."

IV.—The Corona.

With regard to this phenomenon, Mr. Meeson writes:—

"The general outline of the corona, towards the latter part of the period of totality, was, as it appeared to me, pretty much as represented in the accompanying chart, though there must have been other leading features which I had not time to observe. Generally its shape was irregular, and there was little or no four-cornered appearance. If there was any symmetry at all, it was as regards the place of the longest streamers (*x* and *y*), which were exactly on opposite sides, and at those parts of the sun's rim which were respectively the first and last to disappear behind the moon. Some of these streamers, particularly those from the upper western limb, and at an angle of about 30° from the perpendicular, could not have been less in length than 1½ times the moon's or sun's apparent diameter, *i.e.*, not less than 1,275,000 miles. The greatest effulgence of light was in the neighbourhood of the longest

streamers, and particularly round about the highest part of the upper limb. The least was in the lower western and upper eastern limbs—in the former of which the breadth was not more than $\frac{1}{8}$th of the moon's diameter, and in the latter, certainly as small as $\frac{1}{12}$th, if not smaller. Although, for the most part, the streamers seemed to radiate as from a common centre—that is, the centre of the sun or moon—yet this was not universally the case; for some (particularly the ray marked *z*) seemed to proceed as from another centre, and interlaced with the more normal gleams. If these observations of mine—which have been compared and checked with similar notes and sketches made by other members of my family, whom I instructed beforehand, as well as I could, what to look for, and how to record—do not tally exactly with any *bonâ fide* photographic pictures of the eclipse which have been obtained in Nelson, two things must be remembered: One is, that the photograph is apt to give only the inner corona—the sierra, or leucosphere, as it is called—which is comparatively well-marked, and of stronger light; while the outer corona, or chromatosphere—perhaps on account of its more delicate light, or because there is inadequate exposure, or for some other reason—is very likely to be not at all represented. The other point to be remembered is, that the corona, or at all events the outer corona, varied in appearance at different periods of time during totality, for the rays visibly increased in length and altered in shape during observation. I read in Proctor's 'Sun' (page 314) that 'the sharpness of outline in photographs of the corona is due to peculiarities in the process of development, special care being needed to prevent over-development of the negative.' The corona in our eclipse was certainly not very sharply defined, for it was very difficult to say where the faint coronal tints ended and the abnormal hues of the sky began. If, as well as meteoric bodies and the sun's atmosphere, electric action plays a part in the formation of the golden glory which we are discussing, it might perhaps be expected that the appearance of that wonderful light would vary from moment to moment, even as in the case of the Aurora. Upon the whole, the picture which I present seems to agree pretty well with what others, with whom I have compared notes, observed. I noticed no rotatory motion of the beams, such as, I believe, has been sometimes previously observed, nor any flickering or quivering, except as before stated, just before and after totality. Proctor says of the eclipse of 1724, observed in France, that at the beginning of totality Maraldi perceived 'that the corona was wider on the side towards which the moon was advancing than on the opposite side, but that at the close of totality the case was reversed.' This exactly describes what I saw. The most vivid and brightest parts of the corona and the greatest prominences were decidedly

where the moon first touched the sun at the commencement of the eclipse, and at the point directly opposite thereto—that is, where the moon first emerged from before the sun's face. Proctor's generalisation, again, as to the relative development of the outer and inner corona, was certainly confirmed on this occasion. He says :—

"'1. Where any great gap or rift appears in the outer or radiated part of the corona, there a depression is seen in the inner and brighter portion.

"'2. Where the inner portion of the corona is depressed, there the coloured prominences are wanting, and the sierra is very shallow.'

"I think, if you will consider this carefully, you will agree with me, that what we saw confirms the generalisations here given. The colour of the corona, I should say, was that of very brilliant electric light, with, however, a faint but decided tinge of gold."

The Bishop of Nelson gives the following account of the corona, as seen by him :—

"No sooner had the luminous body of the moon established itself on the eyes, and the luminous ring or chromosphere with its protuberances—which seemed to my eye to be at points corresponding to 4 or 5 o'clock, 2 o'clock, and 11 o'clock on the face of the sun, treated as an imaginary clock face—there came the next grand spectacle, *almost* instantaneously, yet with a slight deliberation (worthy as of regal stateliness), with nothing of the scenic or startling transformation slide or scene about it: from the luni-solar disc as a centre, and from the chromosphere, shot forth the glory of the corona from all points—well-likened to a Brunswick star, and, if I may be pardoned for such a matter of fact association and illustration, reminding me of some of those feats of armour decoration which may be seen in the corridor of the White Tower of London, where stars of every order are formed of rays made up of the sheen of bayonets or ramrods, polished and burnished almost as white as snow. There was a tendency to a square shape impressed on the whole, with the exception of what was about the line of the moon's equator, the bright rays extending to quite a distance of $1\frac{3}{4}$ times the sun's diameter on that side, and not nearly so much on the opposite side. . . . On some occasions of total eclipses this corona has been said to be too bright to be gazed at by the unshaded eye, but it was scarcely so on this occasion; one could look at it without pain. It seemed to have a somewhat vibratory movement, coruscations of light playing on the rays of the luminous stars. I saw through the binocular glass certain faint leaf-like bands of light, but too faint and too momentary to make any

record of them. I also saw, before totality, bright rays crossing like St. Andrew's cross."

Dr. James Hudson remarks, with regard to the corona: "I can only speak certainly of the long projection, which I estimated at the time to extend three-fourths of the moon's diameter from the surface of the disc. This long projection appeared to me to be bifurcated at its extremity."

V.—The Bands or Rays of Light, immediately before and after Totality.

Mr. Meeson says, "This was a wonderful and unexpected phenomenon. While sun-gazing, perhaps a minute or two before totality, one of my party called out, 'Look! look at the waves of light behind us!' I turned, and was surprised to see a most beautiful effect, how produced, I cannot tell. It was as if streamers of light shot out from the quarter of the heavens where the eclipse was taking place, like the slender spokes of an enormous wheel of light, neither the nave nor the tire of which could be seen. All the time, too, the 'wheel' seemed to be rotating towards the west. The bands, as they stretched and quivered across the Waimea Plains, far as the eye could see, appeared to be about six or nine inches broad, and about the same space apart. Their direction was undoubtedly from north-east to south-west, and their colour was that of ordinary sunlight, only considerably subdued. During totality they disappeared, but on the sun's reappearance they were again visible, and riveted attention. Surely, thought I, the old fable is right, after all. There *is* a chariot of the sun! Phœbus, the son of Latona, guides it, and these bands are the light from his glorious wheels, as he drives majestically through the heavens. Yet, why visible now, and now only? And how is it that they do not seem to have attracted attention before now, when eclipses have occurred? You all saw what I am referring to. What were those quivering, mysterious, illimitable rays? Were they atmospheric, meteoric, spectroscopic, lunar, or coronal in origin?

"I could almost fancy that they were in the direction of the strongest coronal light, and might be produced by the *coronal rays*, which, before now, have been said to actually rotate. (Proctor's 'Sun,' p. 338.) The coincidence in point of time of the appearance of the two things is worth noting, as is also the coincidence of disappearance. But then it must be remembered that during totality, when the corona was most vivid, the bands of light were either absent altogether or exceedingly faint; at least that is my impression, though I cannot be positive about the fact, for at the time of total eclipse, my whole attention was

absorbed by the passing moon, and the coruscations of light about its limbs. Unfortunately man has not, like insects, compound eyes, enabling him to see at the same time both what is behind and what is before. If the ordinary beams of the corona did not produce the bands of light, *did the exceptional quivering rays, which appeared just before and after totality, above and below the sun, and referred to early in this paper, do so?* Or were the prominences or protuberances the cause of these mysterious bands? I mean, was their appearance in some way spectroscopic, as well as spectral?

"We must remember that, for spectroscopic effect, we had virtually an isolated and thin pencil of light from the sun, and possibly from the prominences only, immediately before and after totality, and, furthermore, that the sun-prominence spectrum consists of bright lines; and perhaps something invening between the sun and the earth—atmosphere, meteoric bodies, vapour—operated as a prism to produce refraction (just as rain does to produce the rainbow), or as a fine grating to produce diffraction. I think that the dark colour between the bands of light was the same as the general colour of things at the time; in other words, not that the bands of light were alternated with dark bands, but that they were simply light bands on a dark surface. Otherwise, the dark bands might suggest the innumerable dark lines of the spectrum, rendered visible in some mysterious way by the exceptional circumstances, with intervening bands only approximately and relatively light, but really of various colours, or in some way divested of colour. But then the dark lines of the spectrum, though innumerable, are very irregularly disposed; whereas the dark lines which we saw, if they were dark lines at all, were very evenly and regularly distributed, and alternated invariably with light bands, and the light and dark seemed to be exactly of the same breadth. My knowledge of the spectrum and its laws is very small, too small to permit of my doing more than suggest questions, which perhaps may very easily be disposed of.

"If these suppositions be unentertainable, was the phenomenon atmospheric in origin? Evaporation in the hot sunshine can often, as is well known, be seen most distinctly, the moisture, as it ascends from the ground, being rendered clearly visible by its quivering motion to the height of several feet. It can also be seen in long and strong streaks through a mass of distant clouds in certain conditions of weather. There was a rapid change of temperature about the time of totality, but it was towards a lower point, not towards a higher, and the lost degrees were not recovered till nearly half-past eight o'clock, as has been already explained. The quivering motion of evaporation occurs during exceptional heat, when the ground is, through recent rains, moist. The circumstances do not seem to be at all

parallel, nor, indeed, are the phenomena, for the matter of that; for our bands of light were broad, well-marked, and, I think, only slightly quivering, very different from the tiny, tremulous, hair-like threads of moisture seen during extensive evaporation. If these bands, then, were atmospheric in origin, how were they produced?

"I read (Proctor's, 'Sun,' p. 362) that General Meyer saw, from White Top Mountain, in Virginia, during the total eclipse of 1860, something similar, except that the bands were of various colours, and do not seem to have moved. He says: 'It was as if bands of broad ribbon of every conceivable hue had been stretched in parallel lines half round the universe.'

"If there had been such a thing as a lunar atmosphere, it might have been conceivable that the bands were in some way owing to the pencil of rays from the sun, just before and after totality, passing through that atmosphere on its way to the earth. But we are assured that there is no atmosphere worth speaking of in the moon; if one exist at all, it is of exceeding rarity. However, even a very thin, ethereal atmosphere, particularly if in the places where the rays intersected it, full of foreign matter of any kind, liquid, solid, or gaseous, would possibly occasion the spectral appearance, of the cause or causes of which we are in doubt.

"It has been seriously suggested by some of our members, that the bands perhaps represent successive jerks forward, made by the moon in its passage across the sun! Now, we must be well aware that there can scarcely be anything of the nature of a jerk or leap in the orbital motions of the heavenly bodies, as the forces producing those motions are steady, continuous, ever-pressing, eternal. Is it possible, however, that we can apply the atomic theory to motion, as well as matter? Of course, the movement of the heavenly bodies, inconceivably rapid as it is, is, at our distance (except in the case of meteors, shooting-stars, etc.) imperceptible, unless we look for a difference of position at consecutive points of time. But so is the movement of a man or a horse at a considerable distance, when going really at a very quick pace; as we approach nearer, however, we see that the movement which, further off, appeared so easy, even, and regular, really consists of a series of jerks forward. Just as, too, in the case of a railway train. If we had power of vision quick and keen enough to analyse the easy motion along the lines, we should see, I imagine, that it consisted of a series of jerks, each of which would represent the result of a contest between the power of steam and the resistance of friction. Now, apply this kind of reasoning to the motion of a celestial body, a star or planet, in its orbit. We know that, in accordance with the parallelogram of forces, that motion is in the direction of a diagonal between two lines, the one of which represents in length

and direction the centrifugal force, the other the centripetal. How, however, does the heavenly body comply with these forces, or, rather, acquire the direction of their resultant, except by a series of steps, so to speak, down or up a ladder—*i.e.*, by alternately giving way to one force and then to the other, each movement representing an atom of time as well as an atom of space? Granted that the atom of motion thus conceived of had real existence, the effect in light and shade, considering the magnifying effect of the great distance, *might be* possibly such bands of light as those we saw on the morning of the 9th September.

"This, however, you must understand, is only an attempt—and a bad one—to put another's crude suggestion into something like philosophical form. My own opinion is that the bands of light, in some way, were produced by the coronal rays, perhaps aided by something exceptional intervening in the space between them and the surface of the earth. But then, the non-appearance of the bands during totality seems a difficulty. I shall be very curious to hear what interpretation the astronomers in the old world put upon this phenomenon: and, by the way, I have not noticed that the observers in Wellington District observed it at all, though I can scarcely believe but that they did. If it were confined to the Nelson Provincial District, that surely would be a strong argument for thinking that the bands were simply produced by some local and temporary peculiarity in our atmosphere.

"Just one personal word in conclusion. I make no pretension whatever to astronomical knowledge or acumen. Carlyle is quoted as having said somewhere: 'Why did not somebody teach me the constellations, and make me at home in the starry heavens, which are always overhead, and which I don't half know to this day?' That was my feeling the other morning. With a hand trained for telescopic and other instrumental work, and an eye trained for the observation of heavenly objects, and a mind stored with astronomical principles and facts, the chance we have just had of observing and recording wonderful, rare, and mysterious phenomena was one which could have been used to grand advantage. Such a chance will probably never again fall to the lot of any of us."

The Bishop of Nelson states in his paper: "I am told by those at Collingwood that on the snow-covered hills above the Aorere there were broad *belts of colour of all shades*, and that the lighthouse and the Spit looked from Collingwood as if they were close at hand, within walking distance."

Mr. Atkinson writes: "As the sun was just disappearing, the most striking phenomenon I witnessed, looking straight at it, was a strongly-marked 'pulsation' in its light; those who were looking away from it saw waves of shadow passing rather rapidly along the ground, just after as well as just before totality. This,

also, I supposed was from the unsteadiness of the air; but to me it seemed certainly not the least striking part of the great spectacle to see the sun flickering, as it were, before it went down."

Dr. J. Hudson says on this subject: "About five minutes before totality I was standing with my back to the sun, looking on the ground in front of me, when I saw fine films floating over the surface of the ground. I rubbed my eyes, thinking there must be water in them, and looked again; there were the films plainer than before. Soon they began to take more definite shape, and appeared as long bands of light and shade, moving rapidly across the field of vision from E.S.E. to W.N.W. I thought for a moment, were they the shadows of clouds of mist? I looked up, but the whole atmosphere was perfectly clear, besides there was no wind; I held up my hand to feel, and it was then what I should call a dead calm. However, there were the long lines of light and shadow travelling rapidly in a westerly direction, and more and more distinct did they appear until the moment of totality, when they completely disappeared, to re-appear again when totality was over. I cannot say what direction they travelled in after totality."

Mr. A. Coleman, in his "Observations on the Solar Eclipse," says:—

"The phenomenon which most struck me, and to which I believe I paid the most attention, was the peculiar vibratory shadows which passed across the earth's surface during the eclipse. Scientific observers have no doubt recorded and fully accounted for this striking phenomenon, but never having read of such, nor having seen any explanation for them, I venture to offer one, which, however, may neither be original nor correct. A curious property of light, discovered by Grimaldi in 1665, later on independently by Newton, but more thoroughly investigated by Fremel, was that termed the inflection or diffraction of light. When a divergent ray of light admitted into an apartment was just intercepted by an opaque spherical body of a suitable size and at a suitable distance, surrounding the shadow cast upon a screen were seen concentric rays of coloured light, 'the fringes' of Grimaldi, whilst in the shadow itself were to be seen alternate light and dark bands of light.

"In investigating this latter phenomenon, Dr. Young saw that they were capable of a satisfactory explanation upon his admirable and comprehensive undulatory theory. To use his own words, 'the fringes within the shadow were produced by the interference of the rays bent into the shadow by one side of the body (intercepting) by the rays bent into the shadow by the other side.'

"In the present instance the moon's disc formed the obstructing body, causing the light and dark bands in its

shadow on the earth's surface, and their flickering movements were due to the moon's movement altering continuously the distance of the undulations from either side of the moon, and with them the positions of the shadows."

Observing at Tahoraite, Mr. A. McKay, of the Geological Department, remarked the flickering of different shades of light at the surface of the ground, and on looking up obliquely towards the sun, saw most distinctly undulating vibrations in the air like those produced by ascending currents. From his position he had a favourable opportunity of observing during totality the return of the light in the rear of the shadow on the Ruahine Ranges, 6,000 feet in altitude, and about 6 miles to the westward, and he distinctly saw the light advancing as banded streamers.

Note.—The Ven. Archdeacon Stock has called the Editor's attention to the following extract from the London *Athenæum*, August 2nd, 1851, p. 821, which evidently points to a similar phenomenon having been observed on the occasion of a previous total eclipse :—

"*Great Solar Eclipse.*—In observing the solar eclipse here yesterday, during the intervals that the showery and cloudy state of the weather permitted, I noted the following fact, which I am not aware has been before observed, and which may be interesting as in a great degree explanatory of some of the most remarkable phenomena attending total eclipses. The rays passing close to and over the moon's body were much agitated. This I at first was inclined to ascribe to the vapoury state of the atmosphere, but soon noticed that could not have been the cause, as the light from the sun's external limits was calm, and gave a most distinct marginal line, while that portion of the sun's face which was bounded by the convex and dark outline of the satellite and that outline seemed to be *dancing together*. In case of any mistake, I caused two friends successively to examine the appearance, and they both reported it to be distinctly such as described. The instrument used was a Newtonian reflector, of 6 inches diameter, with a magnifying power on of about 180.—I am, &c.—P. McFarlane.—Comrie, Perthshire, July 29, 1851."

EXPLANATION OF PLATES XIV.—XVI.

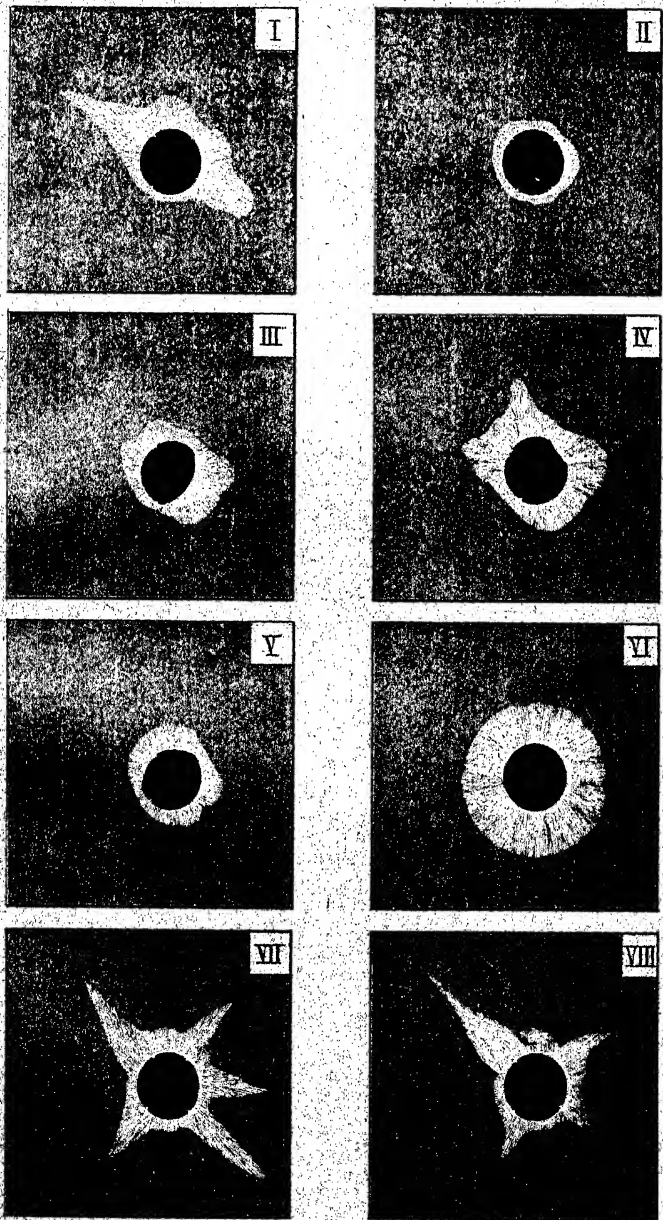
Fig. 1.	Combined from several.		Eye sketch, Wellington (Petone).
2.	Mr. Gell	.. ..	Photograph print, Wellington.
3.	Mr. Holmes	.. ..	" " "
4.	"	.. ..	" " "
5.	"	.. ..	" " "
6.	Mr. Parsons	.. ..	Telescopic sketch (high power), Wellington.
7.	Mr. Higginson	..	" " (low power), "
8.	Mr. W. B. Hudson	..	" " " Karori.
9.	Mr. T. W. Kirk	..	Eye sketch, Wellington.
10.	"	.. ..	" "
11.	"	.. ..	" "
12.	Mr. Goodbehere	...	Photograph print, Taonui.
13.	Mr. Goodall	.. ..	Eye sketch, Tahoraite.
14.	Mr. Harding	.. ..	" Danevirke.
15.	Mr. McKay	.. ..	" "
16.	"	.. ..	" "
17.	Mr. Seymour	.. ..	Telescopic sketch, Picton.
18.	Mr. Tyree	.. ..	Photograph print, Nelson.
19.	Bishop of Nelson	..	Eye sketch, Nelson.
20.	Mr. Meeson	.. ..	" "
21.	Mr. Innes Jones	..	" "

Art. LX.—*The Maintenance of the Sun's Heat.* By Professor F. D. Brown. *(Abstract of a Lecture.)*

[Read before the Auckland Institute, 29th July, 1885.]

The maintenance of the sun's heat: of what possible interest is this? perhaps you will say. Nevertheless, it is recorded that, centuries ago, a man was tending a flock of sheep, when he saw "a flame in the midst of a bush, and the bush burned with fire and was not consumed." And this man, although he lived at a time and in a country where no spirit of inquiry existed, yet thought that this was a matter of the greatest interest, for he said, "I will now turn aside, and see this great sight, why the bush is not burnt." Why, then, should we not turn aside for a few minutes, and ask ourselves, How is it that that great blazing mass, which daily lights and warms us, burns, and is not consumed? But it may be said that there is here a pure assumption introduced, to lend a fictitious interest to the subject; that there is nothing more remarkable in the existence of a vast mass of matter at a white heat than at any other temperature, and that the extraordinary statement that the sun is not consumed has no basis in fact, or, at any rate, cannot be proved.

The first point, therefore, for us to consider is, whether the sun does behave in a manner altogether different from ordinary fire, or a white-hot ball; whether he keeps on shining longer and more fiercely than a fire of his size could do. The solution of this question is by no means difficult, though it involves the use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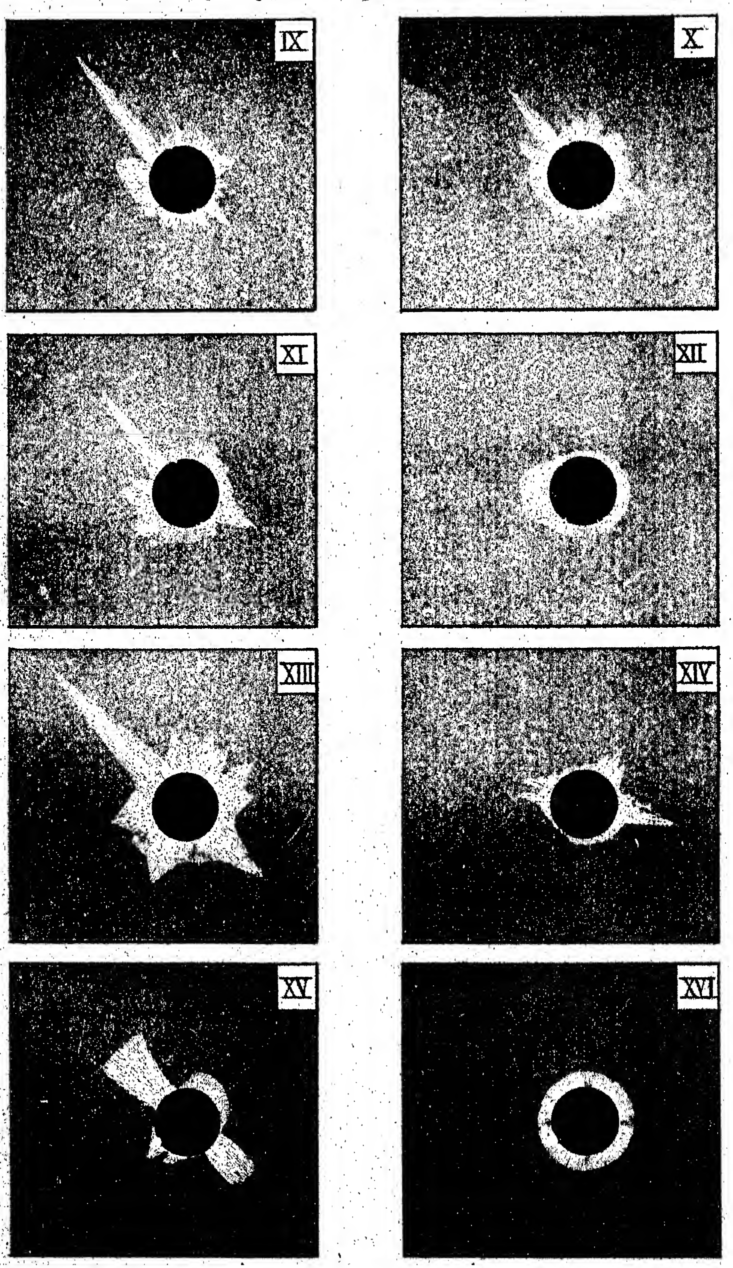
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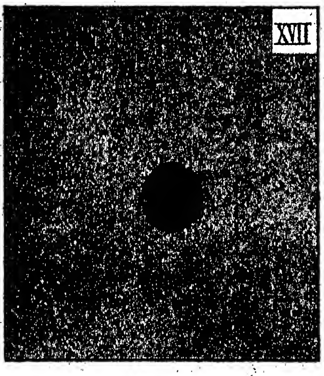
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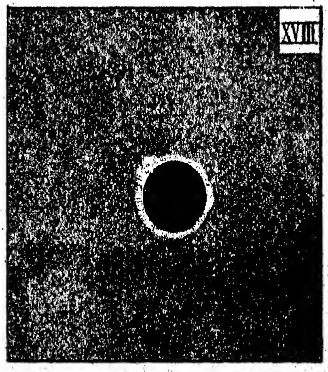
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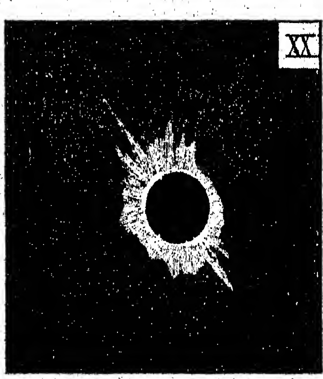
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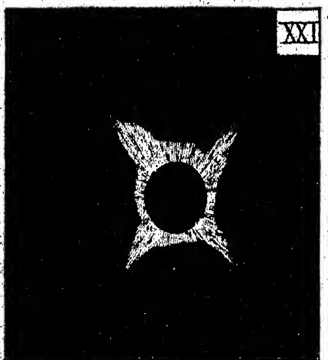
XXI

of some very large figures. It is evident that we must first find out how much heat the sun loses in an hour, or a week, or a year, and then compare this amount with the quantity which could be evolved by a hot or burning body as big as the sun.

We are all of us fully aware that the sun radiates heat, but there are probably only a few here who have ever thought about the quantity of heat thus radiated, or who have any definite idea of the enormous thermal loss which the sun daily undergoes.

To learn how much heat the sun loses in a given time, we must measure the amount of radiation on a given area of the earth's surface. Since the radiation is going on simultaneously in all other directions, it is clear that every square mile on the surface of a sphere of which the radius is 95,000,000 miles will be equally warmed; we must therefore, to find the total radiation, multiply the number we have obtained by the number of square miles on the surface of this sphere, that is, by 108,000 million million. Many measurements of the solar radiation have been made with more or less perfect apparatus. The first, which were carried out at the Cape of Good Hope by Herschel, led to the conclusion that the solar radiation on a square mile would raise 47,500,000 lbs. of water from freezing to boiling in an hour. In obtaining this result, however, no account was taken of the large amount of heat absorbed by the atmosphere, an amount which varies with the humidity of the air, and with the obliquity of the sun's rays. Allowing for this atmospheric absorption, and basing our calculation on the experiments of Violle, which are probably the most exact, we find that the solar radiation per square mile per hour, just outside the earth's atmosphere, would raise 85,500,000 lbs. of water from freezing to boiling. Multiplying this number by 108,000 million million, we obtain an expression for the total hourly solar radiation which is, according to Tyndall, sufficient to boil 700,000 millions of cubic miles of ice-cold water per hour. If, now, we consider how this loss would affect the temperature of a hot body of the mass of the sun which received no heat from any source, we find that it would result in a fall of the sun's temperature of at least 2° C. annually, or 10,000° in 5,000 years; yet all the evidence accumulated by geologists goes to show that in bygone ages the sun's rays were no hotter than they now are. If, on the other hand, we suppose that the sun is a vast burning mass, we find that if it were made of solid coal, and were burning at a rate sufficient to yield this enormous supply of heat, it would be all consumed in 6,000 years. As no apparent diminution of the solar radiation has taken place for thousands of years, I was justified in comparing the sun to the bush in the desert, which burnt, yet was not consumed.

Two well-known hypotheses have been set up to account for the maintenance of the sun's heat; the one ascribes it to a great

shower of meteorites, the other to the gradual contraction of the sun's mass. To appreciate the meteoric theory we must remember that whenever the motion of a body is destroyed, and no other motion set up in its place, heat is evolved; thus, when I bring this hammer on this piece of lead its motion is stopped, and the lead thereby becomes hot. (*Exp.* with thermopile.)

The heat thus generated is proportional to the mass of the moving body and the square of its velocity, and is so great that if the earth fell into the sun, the heat generated would be equal to that obtained from the combustion of 5,600 worlds of solid carbon. There is, therefore, nothing improbable about this meteoric theory, and its supporters go so far as to point to the zodiacal light as material evidence of it, saying that this light is emitted by a vast meteoric cloud. The adequacy of this theory, as regards the possible supply of heat, is well brought out in the following table, which is due to Sir W. Thomson:—

	Years.	Days.
Mercury	6	219
Venus	83	326
Earth	95	19
Mars	12	259
Jupiter	32,254	0
Saturn	9,652	0
Uranus	1,610	0
Neptune	1,890	0
Total	45,604	103

It is, however, very doubtful whether there is any such supply of meteoric matter as is required by this hypothesis. The earth encounters but little, and there is no valid reason to suppose that the zodiacal light results from meteoric matter.

The second hypothesis, which is due to Helmholtz, refers the sun's heat to the simple contraction of its mass; and, in order to show the sufficiency of this theory, it has been calculated that the contraction of the sun from a nebula the size of the orbit of Neptune to its present bulk would yield a sufficient heat to maintain the present rate of radiation for 120,000,000 years, while a contraction of the sun's diameter of about 300 feet per annum would make up the yearly loss. The chief obstacle to the acceptance of this explanation of the origin of the sun's heat is the fact that the heat due to contraction would be set free throughout the sun's mass, and that it is almost impossible to imagine it reaching the surface in time to prevent the sun's surface from becoming cold.

Either of the two hypotheses which I have briefly put before you account fairly well for the fact that, in the period of a few thousand years during which some sort of written record has been kept, no diminution of the sun's heat has been observed;

but both of them place a limit to the solar life. In the case of the meteoric theory, it cannot be supposed that the supply of meteors is inexhaustible; we must look forward to the time when every stone wandering in the planetary spaces shall have fallen into the sun, and when, therefore, the supply of heat shall cease, a time to be followed at no great distance by the dying away of the solar light. Since a mass of matter cannot go on contracting for ever, it is evident that the shrinkage theory, like the meteoric, cannot invest the sun with the attribute of permanence. In this respect they both fail to commend themselves to the mind, as has been said by Sir W. Siemens: "If either of these hypotheses could be proved, we should only have the satisfaction of knowing that the solar waste of energy by dissipation into space was not dependent entirely upon loss of its sensible heat, but that its existence as a luminary would be prolonged by calling into requisition a limited, though may be large, store of energy in the form of separated matter. The true solution of the problem will be furnished by a theory, according to which the radiant energy which is now supposed to be dissipated into space and irrecoverably lost to our solar system, could be arrested and brought back in another form to the sun itself, there to continue the work of solar radiation."

In accordance with this idea, Sir W. Siemens propounded a theory regarding the conservation of the sun's heat, which I will endeavour to explain to you. In order to understand this theory we must suppose that the planetary system is immersed in a rarified atmosphere, consisting mainly of hydrogen, marsh gas, carbonic oxide, water vapour, etc.; that this is no unreasonable assumption is made clear to us by the fact that it has been proved by Maxwell, Clausius, and Thomson that it is impossible to assign a limit to a gaseous atmosphere in space. The nature of this interplanetary atmosphere is, moreover, made known to us by the meteorolites which frequently find their way to the earth; these meteorolites contain gases hidden in their pores, which, being other than oxygen or nitrogen, must, one would think, have been derived from the interplanetary spaces. These gases are those just enumerated. Further proof, if any be needed, of the existence of gaseous matter in interstellar space, is furnished by spectrum analysis, which tells us that the nucleus of a comet contains carbon, hydrogen, nitrogen, and probably oxygen.

Having arrived at a conception of an interplanetary atmosphere, we have next to think of the action of the sun upon it. Let us first investigate the action of any revolving body upon the gaseous medium in which it is placed. (*Exp.*, wheel and candles.)

We thus see that the sun must act like a great fan, projecting the gases from its equator, and drawing them in at its poles.

Let us think of the stream of hydrogen, oxygen, marsh gas, etc., arriving near the sun at its poles; the rise of temperature will evidently bring about combustion, with its accompanying great development of heat. The result of the combustion, the aqueous vapour and the carbon dioxide, will flow to the solar equator, and be projected into space. Thus it would appear that the constitution of the interplanetary atmosphere would be gradually altered; but Sir W. Siemens here steps in with the suggestion that the solar radiation would bring back the combined materials to their original condition of separation, thus enabling them again to flow towards the sun, and by their second combustion supply the central power with further energy. It remains to show how this could take place.

There is no fact better known to students of chemistry than the decomposition of substances by heat. Nearly all organic substances and many metallic salts are resolved into simple compounds by exposure to heat, while such stable bodies as the metallic oxides, and even water itself, are broken up at a high temperature. The explanation of this very general phenomenon is as follows:—The substances are made up of particles, which are all exactly alike, and all complex, being themselves formed by an aggregation of atoms. These atoms, within the particle or molecule, are subject to definite periodical motions or vibrations, which increase in amplitude with the temperature. It is therefore evident that, as the motions of the atoms within the molecule gradually increase in violence, the time must arrive when the cohesive forces which hold them together must be overcome, and the atoms flying off in different directions will either remain at large, or will come into contact with others derived from other particles, forming, in the majority of cases, simpler aggregations. The destruction of the particles is, in fact, not unlike that of a fly-wheel which is rotated more and more rapidly, until at length the centrifugal force overcomes the cohesion of the iron, and the wheel flies to pieces.

Now, it has been shown by Tyndall and others, that vapour of water and other gaseous compounds possess a remarkable power of absorbing the vibrations of radiant heat, the violence of the atomic vibrations becoming thereby greatly augmented. Nevertheless, under ordinary circumstances, no decomposition is apparent. At low pressures, however, the decomposition is greatly increased, and it is reasonable to suppose that, at the extremely low pressure which reigns in the interplanetary spaces, the destruction of the molecules would be considerable.

Here, then, we have an hypothesis which explains how the solar radiant energy is not lost, but gathered up by the particles of matter distributed in space, to be poured again into the sun by the great gaseous current which circulates among the planets.

Let me, in conclusion, sum up the main conditions of this hypothesis :—

(1.) That aqueous vapour and carbon compounds are present in stellar or interplanetary space.

(2.) That these gaseous compounds are capable of being dissociated by radiant solar energy while in a state of extreme attenuation.

(3.) That these dissociated vapours are returned to the sun, and exchanged for recombined vapours by the centrifugal action of the sun.

As Sir W. Siemens has remarked : "If these conditions could be substantiated, we should gain the satisfaction that our solar system would no longer impress us with the idea of prodigious waste through dissipation of energy into space, but rather that of well-ordered, self-sustaining action, capable of perpetuating solar radiation to the remotest future."

VI.—CHEMISTRY.

Art. LXI.—*On a New Mineral* (Awaruite) *from Barn Bay.*

By W. Skey.

[*Read before the Wellington Philosophical Society*, 21*st October*, 1885.]

On the 28th of September two samples, marked Nos. 1 and 2, were transmitted to the laboratory through the Secretary for Mines, as having been obtained by some alluvial miners working near Jackson's Bay, and given by them to the Warden. No. 1 of these parcels, supposed by the contributors to be impure platina, was found not to contain any platina, and to consist entirely of a pure alloy of nickel, iron, and cobalt, in the form of small nuggetty and water-worn grains or scales, perfectly malleable, of a hardness of about 5· and sp. gr. 8·1. Some of these grains have a little lustre, but most of them are dull, owing to a coating of reddish or greenish red oxides. These grains do not reduce copper from its cupreous sulphate, acidulated with muriatic acid. The following is its composition:—

Nickel	67·63
Cobalt	·70
Iron	31·02
Sulphur	·22
*Silica	·43
Total	100·00

Its formula is 2 N + Fe. It is remarkable for the high pro portion of nickel therein. The richest natural alloy of nicke of which I can find any notice is *Oktibehite*, from the United States of America; it is Ni + Fe, according to which formula there is 51·22 per cent. of nickel present. This alloy (Oktibehite) is of terrestrial origin. Meteoric iron does not often go more than 10 per cent., with a maximum of 20 per cent.; it generally contains carbon.

The New Zealand alloy is undoubtedly of terrestrial origin, and should be found in some basic rock in the vicinity of Barn Bay. The even size of the grains, and their number, together with their richness in nickel and apparent uniformity of composition, support the "terrestrial" theory. The inability of

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* This has all been set free from combination with one or other of these metals.

this alloy to reduce copper from its acid solution of cupric sulphate, is very singular, as both iron and nickel rapidly effect a reduction, separately. This fact shows that the two metals are (in the alloy) combined with each other, and it shows, besides, the unreliability of the copper test for demonstrating the absence of iron alloys from our rock masses, this test being as yet the only one in use for this purpose. Possibly there is a connection, and a close one, between this alloy and the nickeliferous pyrrhotine of the West Coast, which I identified in 1878.

Nickel some time ago was quoted at 12s. the pound; it is supplanting silver (as nickel-silver) for many purposes, such as for harness.

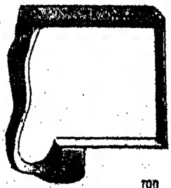
The mixed sand, or wash No. 2, accompanying the alloy, also contained a similar substance, but in smaller grains, while, besides gold—which has escaped the rough appliances of the miners—it contains two kinds of platina, one markedly ferriferous, the other nearly pure. It besides contains tin ore (cassiterite) in quantity, a fact which it appears the contributors did not suspect. This is a new locality for tin ore, and a great deal further south than are any of our other deposits of this ore. The following is the proportional composition of this sand:—

Nickeliferous alloy	24·77
Tin ore	32·14
Magnetite	19·68
Various	23·41
	100·00

Art LXII.—*On Platinum Crystals in the Ironsands of Orepuki Goldfield.* By W. S. Hamilton.

[*Read before the Southland Institute, 26th January*, 1886.]

I have obtained several crystals of platinum from this source, which, though minute, are tolerably perfect, one of the largest of which is figured. It is a square flat tablet, very perfect on three sides, but irregular on the fourth, with one corner deformed. The entablature is very distinct on the face presented, but not on the obverse. There are markings on the surface, as if thin squares and parallelograms of metal had been beaten into it, giving it somewhat the appearance of a brick floor, and suggesting a compound crystal built up of smaller



ones. These crystals occur in the grains of sand. Their occurrence is, however, somewhat rare. The common form in which the platinum occurs is round or oval thin plates, or leaves. But the fact that crystals do occur is important, as proving that the iron-sand is their true matrix. Roughly crystalline platinum also occurs, sometimes with gold crystallised on it, as well as iridium, iron, and native copper. The iron-sand in question is not the ordinary titanic iron-sand of our beaches. It is non-magnetic, or but slightly so, heavier, and lumpier. Lumps of comparatively large size often occur in it, which are iron pyrites derived from wood, and still retaining the original mineral elements of timber, and often some carbon. This is proved from the fact that twigs and small branches are often found along with the sand, completely changed into pyrites, though still retaining the grain, the bark, and all the characteristics of timber. Specimens of these undeniable branches occur where the wood structure is perfect in some parts, while in other parts it is broken up into masses resembling duck-shot, partially fused together. This, I apprehend, gives us the key to the origin of the sand, which seems to be nothing else but the pyritized *dêbris* of ancient vegetation subjected to special conditions, which we may yet come to understand.

Just as wood is often silicified into stone in large quantities, or carbonized into coal, so it would apppear that it may be *metallized* into the iron-sand of our goldfields, auriferous, cupiferous, or platiniferous, from either some obscure conditions of process or inherent quality of the original substance. These pyritized twigs are curiously shrunken to a far smaller size than their original, some of them being reduced to the thinness of needles, whilst still showing wood structure. The iron-sand of many of our goldfields seems to be derived from the breaking down of this pyritized wood by mechanical and chemical means, such as water-wearing and rusting. The sulphur of the pryites is gradually replaced by oxygen to form the *magnetic* oxide, probably determined by the conditions of deposit, temperature, etc. In this way, the magnetic iron-sand of our beaches would be the ultimate product of timber, after being first reduced to wood pyrites, and then broken down by oxidation and the action of mechanical agents, and finally changed into the magnetic oxide, the other metals crystallizing out.

This change can actually be effected experimentally by the artificial oxidation of the non-magnetic lumps of wood pyrites, with the production of magnetite in all respects similar to the titaniferous iron-sand of our shores. Either sulphuric or nitric acid will effect this by long continued action. The grains of sand do not dissolve, but become semiplastic, lose their sulphur, and recrystallize into highly magnetic angular grains of the ordinary magnetic iron-sand.

The renewal of the gold in our beach workings seems to be an example of this slow change of the iron-sand derived from wood pyrites. Miners observe the same renewal of gold in the washings of the Orepuki Goldfield. They save the heavy iron-sand for that purpose, and after a few months, re-amalgamate with good results. This can be repeated ever so often, gold and platinum being continually set free by the chemical changes induced. The fact, as proved in this paper, that both occur crystallized in the sand, affords grounds for supposing that they are really developed or crystallized out of more complex combinations.

NEW ZEALAND INSTITUTE.

NEW ZEALAND INSTITUTE.

Seventeenth Annual Report.

Meetings of the Board were held on the following dates: 30th September, 1884; 3rd February, and 13th May, 1885.

The members of the Board who retired in conformity with clause 6 of the Act were: The Hon. Mr. Waterhouse, Mr. Travers, and Mr Mason, and these gentlemen were reappointed as Governors of the Institute by His Excellency.

The members elected to the Board for the current year by the incorporated societies are: Dr. Buller, Mr. James McKerrow, and Mr. W. M. Maskell.

The following additions were made to the honorary members of the Institute: Professor Asa Gray, Richard Bowdler Sharp, M.A., F.L.S., and R. A. Wallace, F.L.S.

The members now on the roll of the Institute are:—

Honorary members	30
Ordinary members—	
Auckland Institute	304
Hawke's Bay Philosophical Institute ...	121
Wellington Philosophical Society ...	250
Westland Institute	110
Philosophical Institute, Canterbury ...	149
Otago Institute	161
Southland Institute	70
Nelson Philosophical Society	100
Total	1,295

The volumes of Transactions now in stock are: Vol. I. (second edition), 395; Vol. V., 44; Vol. VI., 43; Vol. VII., 140; Vol. IX., 145; Vol. X., 176; Vol. XI., 55; Vol. XII., 62; Vol. XIII., 63; Vol. XIV., 85; Vol. XV., 198; Vol. XVI., 230; Vol. XVII., not yet fully distributed.

The printing of Vol. XVII. was commenced in February, and completed and issued early in May. It contains fifty-five articles, and also addresses and abstracts of articles which are included in the Proceedings and Appendix. There are 536

pages and twenty plates. The following is a comparison of the contents of the volume with that for the previous year:—

	1885. Pages.	1884. Pages.
Miscellaneous	80 ...	72
Zoology	212 ...	324
Botany	94 ...	118
Chemistry	— ...	4
Geology	50 ...	13
Proceedings	35 ...	46
Appendix...	65 ...	62
	536	639

The Honorary Treasurer's statement of accounts is appended. There is still a small amount due on account of the last volume, but, on the other hand, there is a balance to the credit of the Institute in the hands of the London Agent.

Approved by the Board.
Wm. F. Drummond Jervois,
Chairman.

James Hector,
Manager.

18th August, 1885.

New Zealand Institute Account, 1884–85.

Receipts.	£.	s.	d.	Expenditure.	£.	s.	d.
Parliamentary vote for 1884-85	500	0	0	Balance due for printing Vol. XVI.	74	11	5
Contribution from Wellington Philosophical Society, one-sixth annual revenue	24	3	0	Printing Vol. XVII. (on account)	526	18	7
Contribution from societies in aid of printing Vol. XVII. under clause *d* of Regulations of Institute	79	5	0	Miscellaneous items, including binding, &c...	8	4	0
Sale of volumes.. ..	6	6	0				
	£609	14	0		£609	14	0

Arthur Stock,
Honorary Treasurer.

18th August, 1885.

PROCEEDINGS.

WELLINGTON PHILOSOPHICAL SOCIETY.

First Meeting. *24th June*, 1885.

Dr. Hector in the chair.

New Members.—Mr. A. Purdie, B.A., and Mr. W. M. Maskell, F.M.S.

Papers.—1. "On a remarkable variety of the New Zealand Pigeon, *Carpophaga novæ-zealandiæ*," by T. W. Kirk. (*Transactions*, p. 129.)

2. "Abnormal colouring in *Platycercus auriceps*," by T. W. Kirk. (*Transactions*, p. 129.)

3. "New Paper Nautilus, *Argonauta bulleri*," by T. W. Kirk. (*Transactions*, p. 138.)

Specimens Exhibited:—(1) *Ancient Maori kite*, made of raupo, and exhibited by Sir George Grey. (2) Five specimens of *Helix hochstetteri*, presented by Hon. Captain Baillie, whose property near Picton is almost the only place where that shell is now obtained. (3) Specimen of auriferous *Pinolite*, a magnesian rock combined with dolomite, presented by G. S. H. Cox, F.G.S. New South Wales. (4) *A bonita*, a very rare fish in New Zealand, which had been purchased at a fishmonger's shop in Wellington. Dr. Hector took occasion to refer to the reported finding of a *turtle* in Foveaux Straits, and reminded the meeting that a few years ago a turtle came ashore at Island Bay, together with a number of strange fish belonging to the coast of New South Wales, and a mass of kelp. (5) An interesting book, entitled "Cooke's Voyages in the years 1708-11," presented by Mr. Justice Gillies, of Auckland. The book contains numerous plates of birds, beasts, and fishes found in these seas; and New Zealand is marked on the chart as a nebulous patch. (6) Facsimiles of ancient classics, an *Epinal Glossary of Latin* and Old English. (7) Geological specimens from the collection of Mr. McKay, made during his recent survey of the Kaikoura mountains. Dr. Hector spoke for some time on the geology of that district, and testified to the valuable nature of the work being done by Mr. McKay. (8) Portrait in oil of Manihera, recently presented to the Government by the relatives of the deceased, and which had been forwarded to the Museum.

Mr. T. W. Lewis, Under-Secretary for Native Affairs, was present, and gave a short account of Manihera's career, stating that he had been a friend to the settlers from the very early days, and a loyal servant to the Crown.

Manihera's brother (Hoane Rangitakaiwaho), his son (Robert Hector Manihera), and his nephew (John Alfred Jury) were present at the meeting, and the latter, who spoke English with an excellent accent, related some episodes from Manihera's life. He stated that Manihera and Wi Kingi opened the land in the Wairarapa to the settlers; and when Te Hapuku tried to oppose Sir Donald McLean in Hawke's Bay, by refusing to permit the land to be sold, Manihera went up and got Te Hapuku to agree to it. When the Hauhau fanaticism and the King movement spread to the Wairarapa, Manihera used his influence to pacify the Natives with success.

The Hon. Mr. W. B. D. Mantell, M.L.C., said he had held Manihera in very high esteem, but suggested that the portrait would find a more fitting place in the corridor of the House of Assembly.

Dr. Hector differed from this opinion, remarking that, in its present place, the general public would have the benefit of being able to see it.

Before concluding the meeting, Dr. Hector stated that Mr. John Buchanan, F.L.S., who had been connected with the Geological Survey for over 20 years as a botanist, draughtsman, and explorer, was about to leave the Government service, to retire on a well-earned pension; and he expressed, in feeling terms, how much the Society would lose in Mr. Buchanan. He referred at length to the valuable services rendered to the Society during the past 18 years by that gentleman, by his execution of the illustrations and diagrams, as well as by his numerous papers.

Dr. Hector then referred to his personal acquaintance with Mr. Buchanan, and related how, when he left for New Zealand in 1861, Sir Joseph Hooker gave him the name of John Buchanan, as that of a remarkable botanist, stating that if his services were secured in connection with the Geological Survey, a great benefit would be rendered to science.

A few months after landing, the speaker made his acquaintance, and they had been together ever since. They had undergone many hardships together, having on one occasion spent five or six months in the dingy cabin of a little schooner, when exploring the West Coast Sounds, with rain falling steadily for six weeks at a time. He spoke of Mr. Buchanan's ability at designing diagrams and maps, and exploring, or any work requiring the finest artistic touch or taste, in very high terms. At the close of his remarks, the Chairman, on behalf of the Society, handed to Mr. Buchanan an illuminated diploma of life membership, signed by the President, Vice-Presidents, and Council of the Philosophical Society, as a small token of the esteem in which his services were held. The diploma was handsomely illuminated by Messrs. Bock and Cousins. The diploma was accompanied by a present of several valuable books, chosen by the Council. The meeting signified its approval of the gift by hearty acclamation. Mr. Buchanan was quite taken by surprise, and was, in consequence, too much moved to reply at any length.

29*th July*, 1885.

Dr. Grabham, Vice-President, in the chair.

New Members.—Mr. W. E. Vaux, and Mr. John Davies.

Paper.—"On the Improvement in Vegetable Food in Western Europe since Neolithic Times," by W. T. L. Travers, F.L.S. (*Transactions* p. 30.)

Mr. A. de B. Brandon read a paper entitled "Suggestions," with a view to secure uniformity in expression in papers published in the "Transactions," especially in relation to minute measurements; and the meeting generally agreed that such a course would be of advantage.

12*th August*, 1885.

Mr. W. T. L. Travers, F.L.S., in the chair.

Paper.—"On the Maori in Asia," by Mr. E. Tregear. (*Transactions*, p. 3.)

23rd September, 1885.

Dr. Newman, President, in the chair.

New Member.—Rev. E. Durant Cecil.

Papers.—1. "On a New Seismograph, or Earthquake Recorder," by Mr. F. Bull. (*Transactions*, p. 69.)

In concluding his paper, the author said he hoped the instrument would recommend itself to the Meteorological Department for issue to observers.

Dr. Hector agreed that the instrument was a very useful one, but he hardly thought it combined all that was required for very accurate resnlts, and that Professor Milne had lately invented an instrument which seemed to combine all requirements.

2. "On the Life History of a Moth, *Epyaxa rosearia*," by Mr. A. Purdie, M.A. (*Transactions*, p. 208.)

3. "On a New Vegetable-eating *Pill-millipede*," allied to the Spider and the Crustacea, which he proposed to call *Zephronia novæ-zealandiæ*, by Mr. T. W. Kirk. (*Transactions*, p. 139.)

4. "On the Eclipse of 9th September, 1885. (*Transactions*, p. 375.)

21st October, 1885.

Dr. Newman, President, in the chair.

Papers.—1. "On the Maori Language, with Remarks on English Spelling," by Mr. J. C. Crawford. (*Transactions*, p. 46.)

The Hon. Mr. Mantell agreed with the author in regard to the spelling and bad pronouncing of the Maori language by the English.

2. "On the Age of the Napier Limestone," by Mr. A. McKay. (*Transactions*, p. 367.)

3. "On a New Mineral, *Awaruite*," by Mr. W. Skey, Colonial Analyst. (*Transactions*, p. 401.)

4. A large trout, caught by Major Eccles in the Silverstream, was exhibited, and Dr. Hector, after examination, considered it was not a Californian salmon, but the same form of trout which is common in Otago, Canterbury, and Nelson, and that it is probably the progeny of the variety known as "Thames brown trout," which were first introduced into Tasmania, and thence distributed to New Zealand. The fish caught in the Silverstream was a female, with the roe just commencing to develope, and its stomach contained food of fresh-water origin. At first sight it appeared to be very similar to the Californian salmon.

25th November, 1885.

Mr. Govett, Vice-President, in the chair.

New Member.—Mr. G. V. Hudson.

It was announced that the Council had nominated Dr. Hutchinson to vote in the election of Governors of the New Zealand Institute, and this was confirmed by the meeting.

Papers.—1. "On the Coniferous Plants in the Botanic Gardens at Wellington," by J. Buchanan, F.L.S.

Dr. Hector, who read this paper, said that it was a most valuable contribution, containing a complete list of trees grown in the gardens, with remarks on the habits of the trees and the influence of the climate on them, also remarks as to the attack of blight on these pines. The author pointed out the advisability of growing more trees of the gum family. This was the last work of Mr. Buchanan, and would be most useful in future planting in this colony.

Mr. Kirk agreed with what Dr. Hector said. He thought this good work should be continued, and that specimens of these introduced plants should be placed in the museums. He hardly thought the gums would prove a good substitute for the pines. Mr. Kirk gave some interesting information respecting the growth of gum trees in other countries.

Mr. Maxwell remarked that the blue gum timber cut in New Zealand shrunk to a great extent, he supposed owing to want of age.

Mr. Tregear said that this question of the quality of these timbers could only be settled after having been locally studied.

2. "On the Habits of the South Island Weka, or Woodhen," by Mr. Smith, of Oamaru. Communicated by Dr. Buller. (*Transactions*, p. 131.)

Before proceeding with the paper, Dr. Buller gave a most interesting account of these birds, and exhibited specimens of the different species.

Exhibits :—(1) Cast of a male trout, caught beyond the Hutt Bridge by Mr. Pearcy. It weighed 12lbs., and was similar to the one exhibited at a previous meeting. (2) Photograph of the plant *Fourcroya longæva*, now flowering in the Botanic Gardens, taken by Mr. Davis. (3) Rocks from the Bounty Islands and Antipodes Islands, collected by Captain Grey of the *Stella* ; and a collection from Campbell Island, presented by Captain Greig of the *Kekeno*. (4) An old map of New Zealand (1846), presented to the Museum by Mr. Evans.

Annual Meeting. 1885–86.

Abstract of Report.

During the year seven general meetings of the Society were held, at which twenty-five papers or short notices had been read.

Nine new members have been added to the roll, making a total of 270 members. A Microscopic Section of the Society has been formed, and a statement by the Chairman of the section is attached to this report. Fortnightly meetings of the section are held in this room, and members who wish to join can do so by applying to Mr. Maskell, the Chairman.

Library.—A catalogue has been compiled by the librarian, in which are included all the publications belonging to the Society, with those of the New Zealand Institute, the former being identified by a stamp upon each work. The total number of volumes belonging to the Society now in the library is upwards of 1,300. The works added to the various sections in the library during the year are: donations, 10 vols., and 56 purchased. There are still a large number of new works already ordered, but not yet received ; and besides this, the members have the advantage of using the large donations which are added yearly to the Institute Library. Eighteen of the best scientific journals, British and American, are received regularly.

The balance-sheet appended shows the receipts to have been £322 1s. 8d., including the balance brought forward from the previous year (£195 0s. 8d) ; the expenditure, £176 6s. 4d. ; and the balance now in hand, £145 15s. 4d.

Report of the Microscopic Section of the Wellington Philosophical Society.

The section has held numerous meetings during the year. Having decided that the definite work of the section should be the investigation of the fresh-water Infusoria of the Wellington District, the members have devoted themselves exclusively to this work, the result of which is shown in the paper submitted with this report, containing a catalogue of 44 genera, containing 43 species believed to be identical with those of other countries, and 7 species which the section, after full cosideration, believe to be new to science.

Having ascertained that the genus *Vorticella* had already been studied by Mr. T. W. Kirk, and that he had in preparation a paper on that alone, the members of the section decided to omit all study of the genus, and the *Vorticellæ* of Wellington are given in a separate paper by Mr. Kirk, read before a meeting of the section, and also submitted with this report.

The section ventures to hope that the Society will afford greater assistance to microscopical investigation, by the purchase of works of reference necessary for the study of particular subjects, such as Kent's "Infusoria," Schmidt's "Atlas of the Diatomaceæ," Ralfs' "Desmidiæ," Rabenhorst's "Algæ," and many others that could be named.

In view of the importance of microscopic study in a new country like this, the section would beg to suggest that the Council should make such additions to the library.

W. M. Maskell, Chairman of Section.

Papers.—1. "On the Metamorphosis of a species of Caddis Fly (*Phryganedæ*)," by G. V. Hudson. (*Transactions*, p. 213.)

2. "On an Edible Fungus (*Cyttaria purdiei*)," by John Buchanan, F.L.S. (*Transactions*, p. 317.)

3. "On *Vorticellæ*," by T. W. Kirk. (*Transactions*, p. 215.)

4. "Journey to Murimotu and Ascent of Ruapehu," by J. Park.

5. "Additional Contributions to the Flora of Nelson," by T. Kirk, F.L.S. (*Transactions*, p. 318.)

6. "On a new Variety of Desmid (genus *Triploceras*, Bailey)," by W. M. Maskell, F.R.M.S. (*Transactions*, p. 325.)

Election of Office-Bearers for 1886:—*President*—Dr. Hector, C.M.G., F.R.S.; *Vice-presidents*—Dr. Hutchinson, W. T. L. Travers, F.L.S.; *Council*—Martin Chapman, Hon. G. R. Johnson, W. M. Maskell, F.M.S.; A. de B. Brandon, jun., Charles Hulke, F.C.S., Dr. Newman, R. H. Govett; *Secretary and Treasurer*—R. B. Gore; *Auditor*—W. E. Vaux.

AUCKLAND INSTITUTE.

First Meeting. 1st *June*, 1885.

J. A. Pond, President, in the chair.

New Members.—Mrs. E. Craig, S. Eastham, C. Hudson, J. Kenderdine, J. S. Rutherford, W. Tait.

1. The President delivered the anniversary address.

Abstract.

It is a pleasing duty, in opening this session, to say that, from a monetary point of view, we are in a position of comfort, if not affluence, by the substantial legacy of the late Mr. E. Costley, and the endowment of land by the New Zealand Government. The effect of these gifts will be felt in the future by the increased usefulness of this Institute to aid in the advance of science and natural history, and thus directly to assist in the development of the resources of our colony, and also in conserving that portion of our fauna, as far as possible, which seems doomed to extinction by the advance of new and probably more fitted forms of life.

After reviewing the progress of the colony during the last fifteen years, he proceeded to discuss the sources of natural wealth in the colony, under the divisions of Agriculture, Mining, Manufactures. With reference to them he made the following important remarks:—

With the enrichment of the food supplies of the sheep, and the introduction of imported grasses in the place of some at least of the native ones, it will be possible to still further improve the staple, largely increase the carrying capacity of the land, and consequently our producing power.

Now, chemistry has taught us that the soil does not contain an endless store of fertilisers in a soluble form favourable for plant food, and so capable of yielding the amount of nutrition demanded by an unlimited number of stock; and it must not be forgotten that, in the export of our millions sterling annually, we are also drawing largely upon the stores of valuable material which a long course of years has made available for us in the natural decomposition of the soils.

Let us see, then, what science teaches us in reference to our losses by these exports, of which we are so justly proud.

In the year 1883 our statistics tell us that our export of wool amounted to 28,125 tons, while chemistry informs us that this immense mass of wealth carried away with it also—

Potash to the amount of 1,216 tons.

Nitrogen, equal to ammonia, to the amount of 4,734 tons.

Here we have a loss not generally considered. Possibly the nitrogen of the air may gradually replace that which has been carried away, but the potash is actually a factor of our wealth gone from us.

In respect to the export of grain for that year, we find that the weight of wheat exported amounted to 131,250 tons, and the weight of valuable fertilisers lost with it are in the following proportions:—

Nitrogen, equal to ammonia	3,270 tons.
Phosphoric acid	1,127 ,,
Potash	704 ,,

It will be interesting to see the intrinsic value of these fertilisers. The weight of nitrogen as ammonia from both the wool and wheat is 8,000 tons, and this, calculated at a basis of £15 per ton for sulphate of ammonia, is equal to about £400,000.

The weight of potash from both the wool and wheat is 1,920 tons, which, calculated at the English market rate, comes to £57,600.

The phosphoric acid in the wheat is equal to 5,000 tons of bones, which, at £7 per ton, brings the value to £35,000.

These results, it must be remembered, are for one year.

It was this consideration which led me to urge that care should be shown in attending to the plant food, while considering the pastures of the

In the near future we shall be more forcibly brought to face these losses, as undoubtedly we shall export large quantities of meat, some preserved and some fresh. In the former case the loss will be large, but in the latter it will be much greater; as in the former we shall, at all events, retain the bone to be returned to the land, but in the latter case it will be nearly all loss. Unfortunately, the agriculturist has but little of the effete matter returned to his soil from the actual material withdrawn. The utilisation of the waste matter of our towns is still an unsolved problem, and he who can bring this to a satisfactory issue will indeed deserve the thanks of his fellow men.

While we are reviewing the export of cereals, it will be wise to consider for a moment the immense return from our lands over those of the adjoining colonies. Choosing wheat for the purpose of comparison, though oats, barley, hay, and potatoes show the same excess, and taking the average of ten years from 1873 to 1883, we find the bushels per acre as follows:—New South Wales, 14·92; Victoria, 12·38; South Australia, 7·9; Queensland, 12·5; West Australia, 11·; Tasmania, 18·23; New Zealand, 26·3; while the average return for eighteen years in the United Kingdom was 26·5.

To account for this excess in regard to this colony, we have either to accept as a reason the exhaustion of the lands in the colonies named, or the superior soil or more favourable climatic state of our own colony. On this subject, and reviewing the same disproportionate returns, McIvor gives his opinion on the ground of our much greater humidity, and I have no hesitation in arriving at the same conclusion. It is this constant humidity which causes the more speedy disassociation of the minerals, and the more prolific production of plant food. As we see in the cases of the deserts, it requires only water to clothe the sterile plains with vegetation. We must not, however, too heavily discount this most favourable state, or the loss will be greater than we anticipate. As I have already stated, our agricultural wealth is by far the greatest, and it should be our constant endeavour to still further enhance it. The choice of the most luxurious and enriching foods will yield us the greatest returns of butter and cheese from a given number of cattle, and the improvement of this stock alone will fully repay all our care and attention. Consideration should also be given to the cultivation of fibre-producing plants, as these may be sown and won by machine labour, and be sure of a never failing market.

I cannot leave the subject of agriculture without saying a few words on the sugar-beet. As you are aware, I have gone very fully into the examination of roots grown in this district, and find in regard to the amount of sugar contained in them, that they compare most favourably with the results obtained in Germany, and this, when grown with but a tithe of the care required in that country. Chemistry, again, has come to our aid, and shown that the sugar may be extracted in a much more expeditious and cheaper manner than heretofore, especially by the beautiful method of Scheibler and Lamont in the improved strontia process, and as each year passes, these improvements are becoming more practically available. At the same time, the Government of this colony have encouraged the establishment of this industry by large bonuses and protective duties, which should

go far towards making this a thriving work. That it will be carried successfully to completion I am confident, and, in that case, one of the most important results will be in the benefit to our stock by the additional nutritive food supplies, and the benefits to the land by the freeing it from the accumulation of weeds, which, in many parts of this district, in the lighter soils, proves a great drawback.

The subject of agriculture brings us immediately in contact with a wonderful array of insect life, affecting our crops, our fields, and our fruits. Some of them are actually beneficial to us, but the large majority are prejudicial. If we turn to some of the countries which have been ravaged by pests, we will obtain some idea of their magnitude, and the great difficulties and cost which have to be met before their number can be so reduced as to make it possible to continue the raising of the crops. It is but a few years since that the whole world was alarmed at the ravages of the *Doryphora*, better known as the Colorado beetle. Fortunately this pest speedily succumbed, and the alarm abated. Again, for years we have witnessed the efforts made in America and France to check the spread of the *Phylloxera vastatrix*. The loss to France alone from this pest has been so serious as to cause it to be mentioned as a national calamity; and the German Government has, after very large expenditure and repressive measures, been unable to keep that country free from this terrible visitant. In New Zealand, and in this district, we know that this pest has been already acclimated. The manner in which this has occurred does not concern us so seriously as the way in which this and several other pests may be best held in check or actually exterminated. It is here that science opens up a way of combatting these plagues. It is in the study of this insect life that we may hope to attain such a knowledge of their habits and enemies that will enable us to ensure their destruction, while the more careful study of those plants which are the most capable of resisting their aggression will make it possible, by judicious selection, of reducing their harmfulness to a minimum, at the same time cultivating the assistance we may obtain from protection and multiplication of the insects that prey upon those which so injuriously affect us. This work can only be done by the earnest efforts of our entomologists, and I feel it my duty, on behalf of this Institute, to say how indebted we are to the constant and earnest researches made in the study of the Coleoptera of New Zealand by Mr. T. Broun. In the present aspect of knowledge, it is the specialist alone who can make any advance in original research. To the student who has chosen for his theme chemistry, physics, agriculture, or mechanics, the prizes which await his earnest efforts are certain and great, but to those who enter the arena of original research in many of the other branches of science the honours are few, and these alone are the reward.

The study of entomology may prove of great value, not alone in the effort to rid ourselves of a present evil, but to guard against its importation. I have spoken of a few of the pests which affect our success in agriculture, but there is one which, though happily not a denizen of Australasia, may become so unless sufficient supervision is exercised, and the effect of its becoming acclimatised in Australia would be ruinous beyond calculation. I allude to the *Œdipoda migratoria*, better known as the locust. The importation of this insect may not appear feasible; but when we bear in mind how close the countries of its habitat are brought to the shores of Australia by means of the direct steamers, and the risks in importing the fruits of those countries of also obtaining the ova or larvæ of this insect, I do think trouble or expense should not be considered in the efforts to keep these colonies free from this terrible plague. In Cyprus, where the destructive ravages of this pest have been felt severely, the British Government have at great expense done much to reduce their number. In 1881, during the autumn and winter, 1,330 tons of their eggs were destroyed, and 56,116 millions of larval locusts were destroyed by traps and screens. Some idea of the extent of the operations may be gathered from the fact that in one

district there was a continuous line of screens, without a break, for 27 miles in length, arranged in three great loops, connected by a common centre.

These results are of such magnitude, and the ravages of this insect so serious, that I do not hesitate to bring this subject before this Institute, and from this before the kindred societies of the adjacent colonies. Any efforts that are made to guard against such a danger are worthy every consideration, for such a calamity as the introduction of this scourge into Australia, with its vast plains but partially peopled, with such an extent of breeding ground, would result in an increase before which that of Cyprus would be trivial, and the effects upon the Australian Colonies disastrous. It is true that there might be but little risk to this colony; but any serious misfortune affecting the adjacent colonies would also prove injurious to us.

So far, we have been careless to a degree of culpability in not taking steps to guard against the importations of several of these pests, more especially the Codlin moth and Phylloxera, and are still lax in our action in not discovering or introducing means for eradication. The combination of the Australian Colonies to deal with these questions is a matter which has already had a precedent in the expenditure of £40,000 at Geelong in the attempt to exterminate the Phylloxera.

He next reviewed the progress made in meteorology and mining, and concluded with a mention of the chief manufacturing industries, and sources of power that can be utilized.

2. "New species of *Carabidæ*," by Captain T. Broun. (*N.Z. Coleoptera.*)

3. "On a new species of *Chromodoris*," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 137.)

4. "Notes on the Stitch-bird (*Pogonornis cincta*)," by A. Reischek. (*Transactions*, p. 84.)

Second Meeting. 29*th June*, 1885.

J. A. Pond, President, in the chair.

New Members.—D. R. S. Galbraith, W. Goldie, W. F. Hubbard, C.E., G. W. Owen.

Papers.—1. "Objections to the Theory of Evolution," by J. Buchanan.

Professor Thomas criticised the paper at considerable length, and further discussion was postponed until the next meeting.

2. "On the Growth of Transplanted Trees," by J. Baber, C.E. (*Transactions*, p. 311.)

Third Meeting. 27*th July*, 1885.

J. A. Pond, President, in the chair.

New Members.—T. L. Bates, F. Ireland.

The President alluded to the recent death of Mr. J. T. Mackelvie, for many years past a most liberal benefactor of the Institute. Several other members also spoke in reference to the active interest and sympathy always evinced towards the Institute by Mr. Mackelvie.

Papers.—1. "The Maintenance of the Sun's Heat," by Professor F. D. Brown. (Abstract, *Transactions*, p. 394.)

2. "Notes on Parkinson's Petrel (*Procellaria parkinsonii*)," by A. Reischek. (*Transactions*, p. 87.)

3. "Notes on Gould's Petrel (*Procellaria gouldi*)." by A. Reischek. (*Transactions*, p. 90.)

FOURTH MEETING. 24*th August*, 1885.

Hon. Colonel Haultain in the chair.

New Member.—J. Coom, C.E.

Papers.—1. "Notes on Cook's Petrel (*Procellaria cookii*)," by A. Reischek. (*Transactions*, p. 92.)

2. "The Sphygmograph," by J. Murray Moore, M.D.

The author traced the development of pulse-recorders generally, from the first ingenious attempts of the Rev. S. Hales to measure the force and rhythm of the arterial pulsations of the lower animals, to the later experiments of Viererdt in Germany, and Marey in France, on the human subject. The construction of Dudgeon's sphygmograph, the instrument now in general use, was fully explained, and its mode of action pointed out. A large number of diagrams of pulse tracings were exhibited, and the differences in the tracings produced by the action of certain diseases on the circulatory system was clearly and fully demonstrated.

3. "Prehistoric Weapons," by J. Martin, F.G.S.

This was a verbal description of certain stone, bone, and bronze weapons from the Swiss lake-dwellings, presented to the Museum by the late Mr. J. T. Mackelvie, and a comparison between them and similar articles from other parts of Europe and North America. Mr. Martin's remarks were copiously illustrated by lime-light views and diagrams.

FIFTH MEETING. 21*st September*, 1885.

J. A. Pond, President, in the chair.

New Members.—E. Bell, Captain Clayton, G. Cozens, W. Macgregor Hay.

Papers.—1. "Notes on the New Zealand Puffin," by A. Reischek. (*Transactions*, pp. 93 and 95.)

2. "On a new Variety of the *Tuatara*," by A. Reischek. (*Transactions*, p. 108.)

3. "The Influence of the Means of Transit on the Social Condition of the People," by S. Vaile.

SIXTH MEETING. 19*th October*, 1885.

J. A. Pond, President, in the chair.

New Member.—L. Cussen.

Papers.—1. "Description of New Zealand Spiders," by A. T. Urquhart. (*Transactions*, p. 184.)

2. "The Minerals of the Cape Colville Peninsula," by J. A. Pond.

3. "Observations on the Habits of New Zealand Birds," by A. Reischek. (*Transactions*, p. 96.)

SEVENTH MEETING. 30*th November*, 1885.

J. A. Pond, President, in the chair.

1. The President called attention to the Maori Carved House, or *Pataka*, erected in the Museum at the expense of Mr. F. D. Fenton. An unanimous vote of thanks to Mr. Fenton was passed.

2. "Descriptions of three new Species of *Coprosma*," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 315.)

3. "Notes on the Habits of Pole-cat, Ferret, Stoat, and Weasel," by A. Reischek. (*Transactions*, p. 110.)

4. "An Account of the new Volcano in the Friendly Islands," by Rev. S. W. Baker. (*Transactions*, p. 41.)

Dr. Murray Moore read the following extract from the official log of the schooner *Maile*, Captain Lane, in reference to the same volcanic outburst:—

"Position at noon, Friday, 16th October, 1885: longitude, 175° S.W.; latitude, 20° 15′ S. Observed columns of smoke shooting into the air, bearing W.S.W., about 20 miles away. Kept away, and ran within seven miles of it, when we found it to be an active volcano, and that it had thrown up an island about one mile long and over 100 feet high in the centre, sloping gradually all round, with a crater on the E.N.E. side, from which immense columns of matter were thrown continually to a great height; said matter falling again has evidently formed the island, as the crater is on the weather side, and nothing to windward but a low ledge. At sunset the eruption was almost over, only a small jet now and then appearing. The position of the volcano is—longitude 175° 25′ W.; latitude 20° 20′ S.

"[While going before the wind, and when seven miles to windward of the island, some fine gritty dust fell on the deck, which I believe to be pure scoria ash from the volcano.]

"Nov. 21st, 1885.—Left Tonga for Auckland. The volcano is still active; a party, just returned from there in the schooner *Jiole Tafa*, report the island four miles long and 300 feet high. The columns of smoke, etc. shot into the air are visible at Nukualofa anchorage, 47 miles N.N.W., the bearing from thence exactly agreeing with the position formerly given.

W. S. LANE."

5. "The Building Timbers of Auckland," by E. Bartley. (*Transactions*, p. 37.)

Mr. T. Peacock, M.H.R., said he had no doubt that discrimination was necessary in the selection of timber for different purposes. He took excep-

tion to the suggestion Mr. Bartley had made, that the durability of the timber was affected by the time of year the kauri was cut down. After inquiry, he had come to the conclusion that the season did not so much affect a slow-growing tree like the kauri. That was the opinion of experienced persons. As to the statement that the timber was cut too young —2 feet 6 inches was mentioned by Mr. Bartley, which was the minimum size contractors were allowed to cut—he thought the remark made as to 9 inches of sap was not applicable to all districts. He had seen young trees cut, and the sap was only a couple of inches, and perhaps not that. He thought the paper a valuable one, and further investigation might take place in the same direction.

Mr. John Buchanan was a little surprised to hear the wholesale condemnation of kahikatea. His observation on this matter extended over twenty-four years. He knew one house built of kahikatea which had been up for forty years—he referred to Mr. Thorpe's house in the Upper Thames. The timber was decayed at certain parts, but only in those portions of the building where other timbers would be, and certainly not more than other timbers. He had used kahikatea, and had not found the dry rot take place. He had made considerable inquiry from people at the Thames, where it was almost universally used, and he had heard nothing of dry rot. He thought the time would come when kahikatea would be a most valuable timber. The kahikatea he referred to was that grown in swamps; that from Bagnall's mill, for instance, and other parts of the Thames. From his knowledge of the subject, gained from various sources, he thought Mr. Bartley's statement should have been somewhat qualified.

The President (Mr. J. A. Pond) also took exception to Mr. Bartley's statement about kahikatea, and could instance the same house as Mr. Buchanan. From examinations he had made, the hardest kinds came from the swamps. He might mention that a house only a short distance from Thorpe's was bad with rot after standing only three or four years. The property of absorption was very marked in some classes of this timber, and was really the cause of the decay. In the case of one house at Te Aroha, where decay had set in some parts, he blamed to a certain extent the too early painting of the timber. He had given a good deal of time to the subject of the cutting of timbers. He had been assured by mill-owners of twenty and thirty years' experience that there was a great difference between timber cut in winter and that cut in spring and summer. He had verified the fact of the very free discharge of sap in spring and summer. As to totara, there was a house on the wharf where the whole sap and heart had gone in one piece of wood, and this was only after three years. Mr. Bartley had divided kauri into four classes. Whether that was so, or whether the appearance was owing to the location, he was not able to decide, but he rather favoured the theory of location.

7. "The Survival of the Fittest," by E. A. Mackechnie.

Annual Meeting. 22*nd February*, 1886.

J. A. Pond, President, in the chair.

New Member.—W. A. Graham.

Abstract of Report for 1885.

Twenty new members have been elected during the year. The losses have been 24 in all, and may be classified as follows:—From death, 5; from resignation, 8; and from non-payment of subscription, 11. The number on the roll of the Institute at the present time is 300. Regret is expressed at

the death of Mr. J. T. Mackelvie, for many years a most liberal donor to the museum and library.

The total revenue paid into the general account has been £975 1s. 8d. The members' subscriptions have yielded £263 11s., and £582 10s. 10d. have been received as interest on investment. The expenditure has reached a total of £1,078 3s. 3d., thus leaving a debit balance of £103 1s. 7d. The investments standing in the name of the Institute have reached a total of £10,063.

Acting on the authority of a special general meeting of the Institute, the real and personal property of the Institute has been vested in the hands of the Trustees appointed under the Auckland Museum Endowment Act. The Trustees have been incorporated under the provisions of "The Religious, Charitable, and Educational Trust Boards Act, 1884," under the name of the Auckland Institute and Museum Trust Board.

Seven meetings have been held during the year, at which 21 papers on various literary and scientific subjects have been read.

Election of Officers for 1886:—*President*—Professor F. D. Brown, B.Sc.; *Vice-presidents*—J. A. Pond, H. G. Seth Smith; *Council*—J. Baber, C.E., C. Cooper, Hon. Colonel Haultain, E. A. Mackechnie, J. Martin, F.G.S., J. M. Moore, M.D., T. Peacock, M.H.R., Rev. A. G. Purchas, M.R.C.S.E., S. P. Smith, F.R.G.S., J. Stewart, C.E., Professor A. P. Thomas, F.L.S.; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S., F.Z.S.; *Auditor*—J. Reid.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

First Meeting. *7th May*, 1885.

Dr. W. H. Symes, President, in the chair.

New Member.—Dr. Moorhouse.

1. The President read a letter from the widow of the late Dr. F. von Hochstetter, thanking the Institute for the letter of condolence that had been sent to her, and forwarding a heliogravure of the late Dr. von Hochstetter. He announced that the heliogravure would be framed, and hung in the rooms of the Institute.

Paper.—2. "Lucretius," by Professor Haslam.

Second Meeting. *4th June*, 1885.

Dr. W. H. Symes, President, in the chair.

Paper.—1. "Buddha and his Philosophy," by Mr. George Hogben.

Third Meeting. *2nd July*, 1885.

Dr. W. H. Symes, President, in the chair.

New Members.—Miss Lohse and Miss Wilson.

Paper.—1. "River Terraces," by Professor F. W. Hutton.

Fourth Meeting. *6th August*, 1885.

Dr. W. H. Symes, President, in the chair.

New Members.—Rev. T. Taylor, Drs. Deamer and Robinson, Messrs. Gill, Neish, and Chrystall.

Papers.—1. "On the Classification of the Algæ," by R. M. Laing, M.A. (*Transactions*, p. 299.)

2. "On the Brown Sea-weeds of Banks Peninsula," by R. M. Laing, M.A. (*Transactions*, p. 303.)

3. "The Wanganui System," by Professor F. W. Hutton. (*Transactions*, p. 336.)

Special General Meeting. *6th August*, 1885.

Dr. W. H. Symes, President, in the chair.

1. On the motion of Professor F. W. Hutton, it was resolved "That the word 'two' in Law VII. be omitted." This resolution gives to each member the right to admit an indefinite number of visitors to the ordinary meetings.

Fifth Meeting. *3rd September*, 1885.

Dr. W. H. Symes, President, in the chair.

New Members.—Messrs. W. H. Spackman and J. Deans.

Paper.—1. "Thought Transference," by Mr. R. M. Laing, M.A.

Sixth Meeting. *1st October*, 1885.

Dr. W. H. Symes, President, in the chair.

New Member.—Rev. Canon Stanford.

1. Professor F. W. Hutton delivered a lecture on "The Stone Age in Europe."

2. *Papers.*—"Descriptions of New Zealand Micro-Lepidoptera," by E. Meyrick, B.A. (*Transactions*, p. 162.)

3. "Notes on the Nomenclature of the New Zealand Geometrina," by E. Meyrick, B.A. (*Transactions*, p. 184.)

Annual Meeting. *5th November*, 1884.

Dr. W. H. Symes, President, in the chair.

Annual Report.

Eight ordinary meetings and one special general meeting have been held, at which sixteen papers have been read. During the year 13 new members have joined the Institute, but 27 have retired, so that the number of members at present on the books of the Institute is 135. Several additions have been made to the library, and an order for a considerable number of new books, including a complete set of the "Geological Magazine," has lately been sent to London. At the suggestion of the Otago Institute, your Council has again passed a resolution strongly recommending the publication of a new Handbook of the Phanerogamic Flora of New Zealand. Copies of this resolution were sent to the Otago Institute, the New Zealand Institute, and the Colonial Secretary; and it is hoped that the Government will be induced to undertake the work, as it is, in the opinion of your Council, urgently required.

The balance sheet shows total receipts, including credit balance of £13 6s. 7d., to be £204 4s. 2d.; total expenditure, £164 2s. 8d., leaving a credit balance of £40 1s. 6d. The reserve fund, consisting of the subscriptions of life members, is now £56 9s. 7d.

Election of Officers for 1886.—*President*—A. D. Dobson; *Vice-presidents*—W. H. Symes, M.D., and Geo. Hogben, M.A.; *Hon. Treasurer*—H. R. Webb; *Hon. Secretary*—Charles Chilton, M.A.; *Hon. Auditor*—C. R. Blakiston; *Council*—Professors Hutton and Haslam, Messrs. C. E. Bevan, Brown, R. W. Fereday, T. Cook, S. Hurst, Seager.

The retiring President delivered an address on "The rôle of Phosphorus in Nature."

Additional Meeting. 26*th November*, 1885.

A. D. Dobson, President, in the chair.

Papers.—1. "Moas and Moa Hunters," by Professor J. von Haast, C.M.G., Ph. D., F.R.S.

2. "Some Observations on the Stone Weapons of the Morioris and the Maoris," by Professor von Haast, C.M.G., Ph. D., F.R.S. (*Transactions*, p. 24.)

3. "A new species of *Philygria*," by Charles Chilton, M.A. (*Transactions*, p. 159.)

OTAGO INSTITUTE.

First Meeting. 12*th May*, 1885.

Professor Scott, President, in the chair.

The meeting took the form of a conversazione.

Second Meeting. 10*th June*, 1885.

Professor Scott, President, in the chair.

The following resolution was proposed by Mr. G. M. Thomson, and was carried unanimously:—"That the Institute draw the attention of the Government to the recent wholesale deportation of Tuatara lizards which has taken place from this colony, and respectfully suggest that steps be taken to preserve these animals in the localities in which they still occur."

Papers.—1. "Notice of some new Native Plants," by D. Petrie, M.A. (*Transactions*, p. 296.)

2. "On an Index-Collection for small Zoological Museums, in the form of a Genealogical Tree of the Animal Kingdom," by Professor Parker. (*Transactions*, p. 73.)

Third Meeting. 23*rd June*, 1885.

Professor Scott, President, in the chair.

Mr. G. M. Thomson and Professor Parker gave a microscopical demonstration "On the Preparation of Vegetable Tissues."

Fourth Meeting. 14*th July*, 1885.

Professor Scott, President, in the chair.

Professor Black delivered a lecture on "Explosives."

Fifth Meeting. 21*st July*, 1885.

Professor Scott, President, in the chair.

Professor Black delivered his second and concluding lecture on "Explosives."

SIXTH MEETING. 11*th August*, 1885.

Professor Scott, President, in the chair.

New Members.—Arthur Kitchener, J. W. Moore.

Papers.—1. The Secretary read a paper "On the Habits of the Black Woodhen, and of the South Island Crow," by A. Reischek. (*Transactions*, p. 105.)

2. "Note on a Skeleton of *Notornis*, recently acquired by the Otago University Museum," by Professor Parker. (*Transactions*, p. 78.)

3. "Description of a new Species of *Acæna*," by D. Petrie, M.A.

4. "On Inebriety, and the Duty of the State with regard to Inebriates," by Dr. De Zouche.

The following resolutions, proposed by Mr. G. M. Thomson, were adopted:—

(1.) "That, as no work dealing with the systematic botany of New Zealand is now available, the Institute again bring under the notice of the Government the desirability of having a new Handbook of the Phanerogamic Flora of New Zealand prepared and printed, and respectfully urge that steps be taken to have such a work carried out."

(2.) "That as such a work would, in course of time, be largely taken up, so that most of the cost of publication would be ultimately recouped, this Institute undertake to guarantee the disposal of 100 copies, provided the retail selling price of such work does not exceed twenty-one shillings."

(3.) "That copies of these resolutions be sent to the other affiliated Societies of the New Zealand Institute, asking their co-operation in this matter."

SEVENTH MEETING. 25*th August*, 1885.

Professor Scott, President, in the chair.

Dr. Lindo Ferguson gave a microscopical demonstration "On the Preparation of Sections of Bones and Teeth."

Professor Ulrich gave a microscopical demonstration "On the Preparation of Rock Sections."

EIGHTH MEETING. 8*th September*, 1885.

Professor Scott, President, in the chair.

Professor Parker exhibited a pair of very fine trout from Lake Wakatipu, stuffed by the Museum taxidermist.

Dr. Hocken's lecture "On The Early History of New Zealand" was postponed until the next meeting.

NINTH MEETING. 22*nd September*, 1885.

Professor Scott, President, in the chair.

New Member.—Captain Boyd.

Dr. Hocken gave the fourth of his series of lectures "On The Early History of New Zealand."

Tenth Meeting. 13*th October*, 1885.

Professor Scott, President, in the chair.

Paper.—"Regarding Evolution the Previous Question of Science," by the Rev. Dr. Macgregor.

Annual Meeting. 10*th November*, 1885.

Professor Scott, President, in the Chair.

Papers.—"Critical List of the *Crustacea malacostraca* of New Zealand," by G. M. Thomson and C. Chilton. (*Transactions*, p. 141.)

Professor Parker exhibited some botanical models made by him, also a number of stuffed fishes and prepared skeletons, which were to be sent from the museum to the Colonial and Indian Exhibition, 1886.

Abstract of Annual Report.

Eleven meetings have been held during the session. At four of these original papers were read.

During the session a resolution has been passed affirming the desirability of a re-issue of the phanerogamic portion of the "New Zealand Flora." A resolution has also been adopted on the question of the preservation of the tuatara.

Seven new members have been elected, making the total number 197.

The receipts of the session, including a balance of £97 8s. 3d. from last year, amount to £216 5s. 3d. The expenses, including £12 paid as a contribution of 1s. 6d. per member, towards the expenses of the "Transactions," amount to £187 5s., leaving a balance of £29. 0s. 3d. The reserve fund in the Post Office Savings Bank is now £193 3s. 8d.

Election of Office Bearers for 1886.—*President*—Professor Parker; *Vice-presidents*—Dr. Hockin and Mr. G. M. Thomson; *Honorary Secretary*—Professor Scott; *Honorary Treasurer*—Mr. J. C. Thomson; *Council*—Alexander Wilson, M.A., Dr. Petrie, M.A., D. Colquhoun, M.D., F. R. Chapman, J. De Zouche, M.D., H. Skey; *Auditor*—D. Brent, M.A.

The retiring President delivered an address.

Abstract.

In the course of a general review of the work of the New Zealand Institute during the last seventeen years, he specially dealt with the science of anthropology, pointing out that the ethnological papers in the "Transactions" deal mainly with the Native race—the Maori—and much valuable information is to be found scattered through the volumes. In some respects this is all that could be desired, but some important questions are passed over almost in silence. The numerous papers of Colenso and others tells us much of their habits, history, traditions, and language; but no one has as yet taken up systematically the subject of Maori anthropometry. Here in the South Island we are placed at a great disadvantage. We have few Maoris, and these have largely intermarried with the white race; but in the North Island the Maori, though rapidly decreasing, according to almost all authorities, is still numerous, and it is to be hoped that someone will put on record a careful set of observations of

this kind before it is too late. This, one of the finest of the savage races, ought not to be allowed to pass into decadence before this is done. There are four papers of an anthropometric character in the "Transactions." Three deal with the colour sense of the Maori, and to these I shall refer again. One, read before the Wellington Philosophical Society by Mr. Knox, gives a short description of the skeleton of an aboriginal Chatham Islander. It is printed in volume v., and it is quite within our power to write papers of this kind down here. We may not have the living Maori, but we may surely have his bones, at least his skull. Much may be learned from a series of careful measurements of the skull alone, and this is a branch of the subject to which I shall willingly devote myself when opportunity offers. But I find that Maori skulls are not easily got. Collectors of Maori relics usually look on skulls as curios, and hoard them up in little private museums, where they lie hidden during the collector's lifetime, and after his death, not at all improbably, are lost, or, being unauthenticated, become useless for the purpose I speak of. There is nothing to prevent amateurs measuring and recording the skulls in their collections; but since Broca's time craniometry has become a not particularly easy matter, and the instruments required are expensive. It is, of course, a simple enough matter to take certain measurements of a skull, but the great value of an inquiry of this kind lies in the results being such as may be compared with the work of others. Thus all measurements ought to be done in the same way, and modern anthropologists almost invariably follow the directions of the distinguished Frenchman I have referred to, and for this system of measurements a number of special instruments are required. I hope the time will come when I shall be in a position to publish in our "Transactions" some addition to our knowledge of this subject. The other three papers are devoted to the colour sense of the Maoris, of their power to appreciate and distinguish colours. One of these, by Mr. Stack, is published in volume xii. The remaining two, by Mr. Colenso, are to be found in volume xiv. Perhaps a brief allusion to these papers will not be out of place. Some years ago a theory was propounded that primeval man was colour-blind, that the world to his sense of vision was dull and grey. The sky gave him no sense of blue; for him there was no green in the forests, no yellow, no red in the flowers or the sunsets; these and the rainbow affected our ancestors as but mixtures in varying proportions of black and white. That as the centuries passed on our colour sensations gradually came to us, first red, then orange, then yellow, then green, then blue. That the Homeric Greeks were at the stage of being able to distinguish red and yellow with their shades and mixtures, the second stage of the evolution of the colour sense according to this theory. From that day to this the education of this sense has gone on continuously, and we are now able to see the range of colour from red to violet, but much of the spectrum is yet unmastered. The principal supporters of this theory are Mr. Gladstone and Dr. Magnus, a German oculist. It is mainly by philological arguments that they endeavour to convince us of the truth of their theory, but it would be out of place to discuss the question now, suffice it to say that much was written on both sides in 1877 and 1878, and that two of the papers were read by Mr. Stack. If cultured Homeric man had a feeble colour sense, if green and blue had not then emerged from the pervading grey, then savage man of the present day will also most probably to some extent be colour blind. Mr. Stack, therefore, gives us the result of his 30 years' experience of the Maoris in this matter. Unfortunately, he looks at this experience in the light of the new discovery, and tries to make the two agree. The result is curious. He states decidedly that the Maoris have a very feeble colour sense in all colours; but though they are in advance of the besiegers of Troy, in that they have a certain slight appreciation of green, they were till quite lately still blind to blue, the colour they use in tatooing; also that on the arrival of the Europeans they *all at once* had revealed to them the entire scale of colour. This paper is not convincing, and is mainly interesting as being the cause of

Mr. Colenso's contributions. The conclusions arrived at were so much at variance with what he had been led to believe from his exceptional experience, that he felt he must not let them pass uncontradicted. The result is a very valuable contribution to Maori anthropology. He shows, to me most conclusively, that so far from the Maoris being deficient in sensibility to colour, they are in advance of most of us in that respect. He gives us instances from his own experience of this, and he tabulates a list of 80 words and phrases meaning red and its various modifications. He is very far indeed from believing in the blue-blindness of Mr. Stack. Indeed, one cannot read his paper and have any serious doubt as to the Maori possessing, and having possessed before the advent of the Europeans, a fine perception of colour. In this they agree with other savage races—races whose very existence often depends on their ability to note minute variations in colour. Mr. Grant Allen, who, in his interesting work on the evolution of the colour sense, gives a careful adverse criticism of the Gladstone-Magnus theory, publishes the result of an extended inquiry into the colour perception of existing uncivilized races. He sent out circulars to competent persons, missionaries, Government officials, and others, in all parts of the world, requesting answers to twelve questions regarding the colour sense of the savage people amongst whom they were living. The answers received "bore out in every case the supposition that the colour sense is, as a whole, absolutely identical throughout all branches of the human race." To complete our knowledge of the Maoris in this respect, and to make it more definite and exact, it would be well for someone to test a large number of them with some good colour test, such as Holmgren's wools. This could easily be done by anyone. Nothing but care and patience are required, but the results would be well worth recording. . . . I cannot let you go without alluding to the gaps that death has made in our ranks during the past year. Two of my predecessors in this chair, Mr. Arthur and Mr. Montgomery, have, like the runners of old, handed on the torch of life to others. These gentlemen were well-known and valued members of the Institute, and to both we owe regret and gratitude. Members of our body for a number of years, from first to last they had the interests of the Institute at heart, and in the various capacities of President, Vice-president, and member of Council, they were intimately associated with the many details of its management. Mr. Arthur was one of our oldest and most active members. He joined the Society in 1869, the year of its birth. From 1878 continuously till his death he was a member of the Council, or Committee of Management. He was Vice-president on two occasions, in 1878 and 1883, and he was our President in 1882. It will be long before we forget his enthusiasm as a worker in that branch of science to which he devoted his leisure. To it several of the volumes of the "Transactions" bear worthy and lasting witness. I do not think I go too far, or under-estimate the work of others, when I say that the success of fish culture in Otago is mainly due to Mr. Arthur's zeal and fostering care. Mr. Arthur's papers in the "Transactions" on fishes show where his tastes lay. Up to the last he lost no opportunity of observing and recording what he could of our fishes, native and introduced. Of literary tastes, Mr. Montgomery did not contribute much in the way of papers to our proceedings. But much helpful work may be done in an organisation such as ours in other ways, and in such Mr. Montgomery was always ready and willing to assist. He joined the Society in 1877, and as President in 1883, Vice-president in 1881 and 1884, and as member of Council from 1879, he did good work for us, heartily doing what came to his hand to do.

WESTLAND INSTITUTE.

ABSTRACT OF NINETEENTH ANNUAL REPORT.

The number of members on the roll is 93, and the total receipts, including a balance of £65 13s. 3d., carried forward from last year, amounts to £204 13s. 11d. The expenditure has been £181 16s. 10d., of which £57 3s. 9d. has been spent on additions to the Library and Reading-room. The balance in hand and outstanding credits, after deducting liabilities, is £46 7s. 1d.

During the year there have been eleven meetings of the Committee for the transaction of business.

ELECTION OF OFFICERS FOR 1885-86.—*President*—T. O. W. Croft; *Vice-president*—J. P. Will; *Treasurer*—C. F. A. Broad; *Committee*—W. A. Spence, Wm. Kenny, Jno. Nicholson, H. L. Robinson, A. H. King, C. Horgan, E. B. Sammons, J. W. Souter, G. Clarkson, Captain Bignell, James Park, Rev. H. Gould; *Secretary*—Richard Hilldrup.

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

First Meeting. *8th June*, 1885.

The President, W. Colenso, F.L.S., in the chair.

The President gave an opening address.

Papers.—1. "On the Rev. J. Pearson's Method of Computing Solar Eclipses and Occultations," by J. Harding.

2. "On some Structural Peculiarities in the Sun-Fish (*O. mola*) recently captured at Napier," by A. Hamilton, of Petane. (*Transactions*, p. 135.)

A list of specimens received by the Curator for the Museum since the last meeting was then read. Amongst them was the baleen of *Neobalæna marginata;* the stuffed head of a Sea-Leopard Seal (*Stenorhynchus leptonyx*), from Porangahau, presented by Rev. F. E. T. Simcox.

The Hon. Secretary also showed a dried specimen of the Hammer Shark (*Z. malecolus*), procured at Port Ahuriri, and a collection of fossils from Takapau.

Second Meeting. *13th July*, 1885.

The President, W. Colenso, F.L.S., in the chair.

Papers.—1. "On the Cryptogamic Flora of New Zealand," by W. Colenso, F.L.S. (*Transactions*, p. 219.)

2. "Notes on the recent Solar Eclipse," by J. Goodall, C.E. (*Transactions*, p. 375.)

3. Address by Thomas Tanner, (the Vice-President,) "On the Solar Eclipse," as observed by him at Woodville.

4. An Article by Mr. R. C. Harding, "On the Phenomena observed at Dannevirke, connected with the recent Solar Eclipse."

The Vice-president illustrated his remarks by a large diagram on the black-board, and the other notes were accompanied by diagrams.

Mr. Graydon, a visitor, exhibited a beautiful diagram of the corona, as observed by him.

Mr. Goodall illustrated his remarks on the spectroscopic peculiarities of the corona by exhibiting a spectroscope.

The specimens exhibited at this meeting were numerous, amongst others:—(1) The eggs and young of a species of *Phasma*, by the President. (2) The apex of the lower jaw of a Goosebeak Whale (*Epiodon*), showing the small imbedded teeth. (3) A photograph of a young Pike Whale (*Balænoptera rostrata*), killed at Port Ahuriri. (4) Some parasitic barnacles (*Coronula balænaris*), having *Conchoderma aurita* growing on them. These were exhibited by the Hon. Secretary, Mr. Hamilton.

THIRD MEETING. 12*th October*, 1885.

The President, W. Colenso, F.L.S., in the chair.

1. The President delivered a very interesting address "On the various Legends and Stories current among the Maoris relating to the Sea and Sea Monsters."

2. The Hon. Secretary exhibited a number of specimens recently deposited in the Museum, among others a specimen of a Flying-fish from the Bay.

A number of interesting fossils were exhibited, which had been collected from Pareora beds at the Upper Mohaka, including fine specimens of *Flabellum circulare*.

FOURTH MEETING. 9*th November*, 1885.

The President, W. Colenso, F.L.S., in the chair.

Paper.—1. Remarks "On Feathers of two Species of Moa," by Taylor White, Esq., of Glengarry. (*Transactions*, p. 83.)

2. An Address by the Hon. Secretary, Mr. Hamilton, "On the Circumstances attending the early Discovery of Moa Bones in New Zealand, and their Identification." Mr. Hamilton illustrated his remarks by reference to a nearly complete skeleton of a Moa, deposited in the Museum of the Institute.

3. The President exhibited some remarkably fine specimens of moa bones from the North Island of New Zealand, which had recently been reported on by Dr. von Haast, and found to possess great interest.

4. Mr. Colenso then gave an address "On some other Extinct Birds, more particularly the Dodo and the Great Auk."

Numerous botanical specimens from the Seventy-mile Bush were exhibited by the President and the Hon. Secretary.

Mr. White's paper was illustrated by specimens of moa feathers, and by two coloured drawings of the most noticeable feathers.

FIFTH MEETING. 14*th December*, 1885.

The President, W. Colenso, F.L.S., in the chair.

Papers.—1. "On *Clianthus puniceus*, Sol.," by W. Colenso, F.L.S. (*Transactions*, p. 291.)

2. "On the Bones of a new Species of Sphenodon (*S. diversum*) Col.," by W. Colenso, F.L.S. (*Transactions*, p. 118.)

3. "On some new Indigenous Plants," by W. Colenso, F.L.S. (*Transactions*, p. 256.)

4. "On some Introduced Plants" recently observed by W. Colenso, F.L.S. (*Transactions*, p. 288.)

5. The Hon. Secretary then read a list of the specimens added to the Museum, and gave a short address on the desirability of the study of Natural History, if only as an intellectual recreation.

The President then reviewed the work of the session, and at the close a vote of thanks was passed to Mr. Colenso for his valuable papers.

At the close of the meeting, Mr. Goodall exhibited some diagrams of the recent solar eclipse, published by the Surveyor-General.

Annual Meeting. *4th February*, 1886.

Abstract of Annual Report.

An account of the circumstances attending the removal of the property of the Society to their new premises, and drawing attention to the establishment of the Museum. The Library and donations of books. The number of members now on the roll is 149, 28 having been elected during the year. The audited statement of accounts shows a balance in Treasurer's hands of £ ; fixed deposit in bank, £150; and considerable arrears of subscriptions. The expenditure for the year was £ , principally on museum fittings, and expenses connected with removal.

Five meetings only have been held, at which nine papers have been read, and seven addresses and lectures delivered.

Ten Council meetings have been held.

Appended to report of Council is the Curator's report on the additions to the Museum during the year.

Election of Officers for 1886.—*President*—W. I. Spencer; *Vice-president*—J. Goodall, M.I.C.E.; *Council*—H. Hill, F. W. C. Sturm, S. Locke, N. Heath, J. T. Carr, A. P. Sheath; *Hon. Secretary and Curator*—A. Hamilton; *Hon. Treasurer*—J. N. Bowerman; *Auditor*—T. K. Newton.

SOUTHLAND INSTITUTE.

Annual Meeting. *26th January*, 1886.

Abstract of Annual Report.

During the year six general meetings were held, at which the following papers were read:—

1. "On the Discovery of a Crystal of Platinum in the Orepuki Black-sand," by Mr. W. S. Hamilton. (*Transactions*, p. 402.)
2. "On Sound," by Mr. A. Ireland.
3. "On the Geology of the Bluff District," by Mr. W. S. Hamilton.
4. "On Optical Illusions," by Mr. G. Baker.
5. "On Romance and Sensationalism," by the Rev. H. Stocker.
6. "On Respiration," by Dr. Macpherson.
7. "On Encrinites and Crinoids," by Mr. E. Webber.
8. "On Blood, and the Circulation," by Dr. Closs.
9. "On Population," by Mr. A. Ireland.

The Council arranged with Mr. Daniel for a course of popular lectures on "Chemistry." The attendance at these lectures, although not large, was encouraging.

The Council also assisted in organising a course of lectures on literary subjects, given during the winter months by Messrs. Brown, Wilson, and Waddell, of Dunedin, and Messrs. Gammell, Blanchflower, and Galbraith, of Invercargill.

According to a resolution carried at last annual meeting, the subscription has been reduced to half-a-guinea to those members who do not take the volume of "Transactions." This, as yet, has led to no increase in the roll of members. In the year 1884, 58 members paid one guinea each. In 1885, 17 members paid half-a-guinea each, and 37 members one guinea each, making a total of £47 15s. 6d.

The Library of the Institute has received a number of new works by purchase, and by generous donations of valuable books from the Survey Department of the United States Government, and the Victorian Government.

Including a balance of £57 8s. 5d. brought forward, the total income has been £121 19s. 11d., of which £16 16s. is the proceeds of the course of lectures. The expenditure has been £40 16s. 8d., besides which there is an outstanding account for books, of £20.

Election of Officers for 1886.—*President*—Dr. Galbraith; *Vice-president*—Ven. Archdeacon Stocker; *Council*—Messrs. Bailey, Scrutton, Mehaffey, Cuthbertson, and Dr. Closs; *Treasurer*—Mr. Robertson; *Secretary*—Mr. E. Webber.

NELSON PHILOSOPHICAL SOCIETY.

ANNUAL MEETING. *8th October*, 1885.

The Bishop of Nelson, President, in the chair.

New Member.—Mr. Alfred Jones.

The Secretary's report showed that during the year 9 ordinary and 10 Council meetings had been held, and that 9 original papers had been read before the Society. During the year 17 new members and two associates had been elected, and the total number stood at 95 members and three associates.

The Treasurer's report showed that the receipts for the past year had been £75 9s. 6d., and the expenditure £91 19s. 4d.

ELECTION OF OFFICERS FOR 1885-86.—*President*—A. S. Atkinson; *Vice-presidents*—The Bishop of Nelson and J. Meeson, B.A.; *Secretary*—Dr. Coleman; *Treasurer*—A. K. Somerville; *Council*—Dr. L. Boor, Dr. J. Hudson, J. Holloway, J. S. Browning, and W. S. Littlejohn; *Curator*—Dr. Hudson.

2nd November, 1885.

A. S. Atkinson, President, in the chair.

Papers.—1. "Observations on the Recent Solar Eclipse," by the Bishop of Nelson; (2) by J. Meeson, B.A.; (3) by Dr. Coleman; (4) by the President; (5) by Dr. Hudson. (*Transactions*, p. 375.)

6. "A Rain Chart for the Year," by the Bishop of Nelson.

The Bishop of Nelson was nominated to vote at the election of a Governor of the New Zealand Institute.

7th December, 1885.

A. S. Atkinson, President, in the chair.

Papers.—1. "On Telegraphy," by J. C. Lockley.

2. "A Description of the Stalactite Caves at Collingwood," by J. S. Browning.

APPENDIX.

COMPARATIVE ABSTRACT for 1885 and previous Years.

STATIONS.	Barometer At 9.30 a.m.		Temperature from Self-registering Instruments read in Morning for Twenty-four Hours previously.					Computed from Observations.		Rain.		Wind.		Cloud.
	Mean Reading.	Extreme Range.	Mean Temp. in Shade.	Mean Daily Range of Temp.	Extreme Range of Temp.	Max. Temp. in Sun's Rays.	Min. Temp. on Grass.	Mean Elastic Force of Vapour.	Mean Degree of Moisture (Saturation=100).	Total Fall in inches.	No. of Days on which Rain fell.	Average Daily Force in Miles for Year.	Maximum Velocity in Miles in any 24 hours, and Date.	Mean Amount (0 to 10.)
Auckland	30·170	1·290	58·3	12·5	42·0	149·0	29·0	·352	71	28·140	155	145	922 on 14th March.	6·1
Previous 21 years ..	29·964	..	59·2	..	..	..	..	·398	74	43·48	189	..		
Wellington	30·001	1·343	54·5	12·5	43·0	147·0	29·5	·356	84	36·813	162	163	600 on 19th Sept.	4·2
Previous 21 years ..	29·918	..	54·7	..	..	..	..	·336	72	52·466	158	..		
Dunedin	30·120	1·469	50·8	14·3	52·0	150·0	25·0	·275	74	24·598	167	120	600 on 15th March	5·7
Previous 21 years ..	29·864	..	50·3	..	..	..	..	·278	74	35·145	164	..		

AVERAGE TEMPERATURE of SEASONS, compared with those of the previous Year.

STATIONS.	SPRING. September, October, November.		SUMMER. December, January, February.		AUTUMN. March, April, May.		WINTER. June, July, August.	
	1884.	1885.	1884.	1885.	1884.	1885.	1884.	1885.
Auckland	56·4	56·4	62·3	64·6	58·7	59·7	52·6	52·7
Wellington	52·6	53·5	58·8	60·6	54·3	55·6	48·8	48·3
Dunedin	49·4	50·6	54·7	56·4	50·3	51·7	43·7	44·7

NOTES ON THE WEATHER DURING 1885.

January.—On the whole, showery weather, but total rain under the average; temperature at all stations less than average; some bright, pleasant days; winds moderate. Earthquake felt in North on 15th, at 6.10 p.m., slight, N. and S.

February.—Except in South, the rainfall has been much less than the usual average for this month, and the weather on the whole has been fine, with light variable wind. Earthquake felt on 19th, in North Island, at 8.30 a.m.; very slight; brilliant meteor on 20th.

March.—Generally a wet, unpleasant month, with frequent squalls and cold weather.

April.—Fine weather, with generally light wind and small rainfall.

May.—Showery weather during this month, but no very heavy falls of rain. Wind, on the whole, moderate; temperature, below average.

June.—Fine weather during this period for time of year; little rain, and moderate or light wind; temperature rather above the average.

July.—Weather about the average for time of year. Earthquakes at Wellington, 18th, 9.43 p.m., and on 26th, 7.50 p.m., slight; also at Lincoln on 26th, at same time, slight.

August.—Rain rather under the average, and, on the whole, seasonable weather, though some severe days experienced in the South, with strong winds. Earthquake at Wellington on 5th, at 5.10 p.m., rather sharp.

September.—Generally fine weather during this month, with small rainfall, and about the average temperature.

October.—On the whole, fine for the time of year, except rain in excess at Wellington and squally weather; temperature about the average. Meteor on 20th, to eastward.

November.—Fine generally at all stations during the month, with moderate winds.

December.—Very fine weather at all places, the rainfall considerably under the average; and the temperature was less than the usual average for this month. Earthquake reported on 13th, at 7.15 a.m., and on the 20th, at 7.20 a.m., at Wellington.

EARTHQUAKES reported in NEW ZEALAND during 1885.

Place.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Woodville ..	15*	..	..	..	..	..	..	..	..	..	..	..	1
Hawera ..	..	..	20	..	..	..	..	..	..	..	..	..	1
Feilding ..	..	..	..	..	..	..	26*	..	..	..	..	..	1
Patea ..	..	..	..	..	..	..	26*	..	..	..	..	..	1
Foxton ..	..	..	..	..	9	..	..	5	..	..	..	..	2
Wanganui ..	15*	..	..	..	..	..	..	..	..	..	..	..	1
Wellington	15	19	..	..	..	..	18, 26	5*	..	..	..	13*	6
Blenheim ..	15*	..	..	..	..	..	26*	..	..	11	..	..	3
Nelson ..	15	..	..	..	..	..	..	..	..	..	..	..	1
Ross ..	..	..	..	..	..	20*	..	..	..	..	..	..	1
Christchurch	15	..	..	..	..	..	26*	..	..	..	..	..	2
Ashburton ..	..	..	..	..	..	..	26	..	27*	..	..	..	2
Lincoln ..	..	..	..	..	..	..	26	..	..	..	..	..	1
Timaru ..	..	..	..	..	..	..	..	..	27*	..	..	..	1
Westport ..	..	25*	..	..	..	..	26*	..	..	..	..	..	2
Greymouth	..	..	..	..	..	..	26*	..	..	..	..	..	1
Kumara ..	..	25*	..	..	..	..	..	..	..	..	..	..	1
Hokitika ..	..	25*	..	..	..	..	26*	..	..	..	..	..	2
Oamaru ..	..	27*	..	..	..	..	..	..	..	..	..	26*	2

The figures denote the day of the month on which one or more shocks were felt. Those with an asterisk affixed were described as *smart*, those with a dagger as *severe shocks*. The remainder were only slight tremors, and no doubt escaped record at most stations, there being no instrumental means employed for their detection. These tables are therefore not reliable as far as indicating the geographical distribution of the shocks.

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INDEX.

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TRANSACTIONS

AND

PROCEEDINGS

OF THE

NEW ZEALAND INSTITUTE

1885

VOL. XVIII.

(FIRST OF NEW SERIES)

EDITED AND PUBLISHED UNDER THE AUTHORITY OF THE BOARD OF GOVERNORS OF THE INSTITUTE

BY

JAMES HECTOR, C.M.G., M.D., F.R.S.

ISSUED MAY, 1886

WELLINGTON
LYON & BLAIR, PRINTERS, LAMBTON QUAY
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PREFACE.

The present volume commences a new series of the "Transactions of the New Zealand Institute," in which, for convenience and economy, the size of the page has been reduced from royal to demy octavo. An alphabetical index has also been added to the volume for the first time. A General Alphabetical Index of Authors and Subjects, for the seventeen volumes which constitute the first series, has been prepared, and will be preser
to all members of the Institute along with this

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AUCKLAND INSTITUTE.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

SOUTHLAND INSTITUTE.

NELSON PHILOSOPHICAL SOCIETY.

APPENDIX.

LIST OF PLATES.

NEW ZEALAND INSTITUTE.

ESTABLISHED UNDER AN ACT OF THE GENERAL ASSEMBLY OF NEW ZEALAND INTITULED "THE NEW ZEALAND INSTITUTE ACT, 1867."

Board of Governors.

(ex officio.)

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Secretary: R. B. Gore.

ABSTRACTS OF RULES AND STATUTES.

Gazetted in the "New Zealand Gazette," 9th March, 1868.

Section I.

Incorporation of Societies.

1. No Society shall be incorporated with the Institute under the provisions of "The New Zealand Institute Act, 1867," unless such Society shall consist of not less than twenty-five members, subscribing in the aggregate a sum of not less than fifty pounds sterling annually, for the promotion of art, science, or such other branch of knowledge for which it is associated, to be from time to time certified to the satisfaction of the Board of Governors of the Institute by the Chairman for the time being of the Society.

2. Any Society incorporated as aforesaid shall cease to be incorporated with the Institute in case the number of the members of the said Society shall at any time become less than twenty-five, or the amount of money annually subscribed by such members shall at any time be less than £50.

3. The by-laws of every Society to be incorporated as aforesaid shall provide for the expenditure of not less than one-third of its annual revenue in or towards the formation or support of some local public Museum or Library; or otherwise shall provide for the contribution of not less than one-sixth of its said revenue towards the extension and maintenance of the Museum and Library of the New Zealand Institute.

4. Any Society incorporated as aforesaid, which shall in any one year fail to expend the proportion of revenue affixed in manner provided by Rule 3 aforesaid, shall from thenceforth cease to be incorporated with the Institute.

5. All papers read before any Society for the time being incorporated with the Institute shall be deemed to be communications to the Institute, and may then be published as Proceedings or Transactions of the Institute, subject to the following regulations of the Board of the Institute regarding publications:—

Regulations regarding Publications.

(*a.*) The publications of the Institute shall consist of a current abstract of the proceedings of the Societies for the time being incorporated with the Institute, to be intituled, "Proceedings of the New Zealand Institute," and of transactions, comprising papers read before the Incorporated Societies (subject, however, to selection as hereinafter mentioned), to be intituled, "Transactions of the New Zealand Institute."

(*b.*) The Institute shall have power to reject any papers read before any of the Incorporated Societies.

(*c.*) Papers so rejected will be returned to the Society before which they were read.

(*d.*) A proportional contribution may be required from each Society towards the cost of publishing the Proceedings and Transactions of the Institute.

(*e.*) Each Incorporated Society will be entitled to receive a *proportional* number of copies of the Proceedings and Transactions of the Institute, to be from time to time fixed by the Board of Governors.

(*f.*) Extra copies will be issued to any of the members of Incorporated Societies at the cost price of publication.

6. All property accumulated by or with funds derived from Incorporated Societies and placed in the charge of the Institute, shall be vested in the Institute, and be used and applied at the discretion of the Board of Governors for public advantage, in like manner with any other of the property of the Institute.

7. Subject to "The New Zealand Institute Act, 1867," and to the foregoing rules, all Societies incorporated with the Institute shall be entitled to retain or alter their own form of constitution and the by-laws for their own management, and shall conduct their own affairs.

8. Upon application signed by the Chairman and countersigned by the Secretary of any Society, accompanied by the certificate required under Rule No. 1, a certificate of incorporation will be granted under the Seal of the Institute, and will remain in force as long as the foregoing rules of the Institute are complied with by the Society.

Section II.

For the Management of the Property of the Institute.

9. All donations by Societies, Public Departments, or Private Individuals to the Museum of the Institute, shall be acknowledged by a printed

form of receipt, and shall be duly entered in the books of the Institute provided for that purpose, and shall then be dealt with as the Board of Governors may direct.

10. Deposits of articles for the Museum may be accepted by the Institute, subject to a fortnight's notice of removal to be given either by the owner of the articles or by the Manager of the Institute, and such deposits shall be duly entered in a separate catalogue.

11. Books relating to Natural Science may be deposited in the Library of the Institute, subject to the following conditions:—

(*a*.) Such books are not to be withdrawn by the owner under six months' notice, if such notice shall be required by the Board of Governors.

(*b*.) Any funds specially expended on binding and preserving such deposited books at the request of the depositor, shall be charged against the books, and must be refunded to the Institute before their withdrawal, always subject to special arrangements made with the Board of Governors at the time of deposit.

(*c*.) No books deposited in the Library of the Institute shall be removed for temporary use, except on the written authority or receipt of the owner, and then only for a period not exceeding seven days at any one time.

12. All books in the Library of the Institute shall be duly entered in a catalogue, which shall be accessible to the public.

13. The public shall be admitted to the use of the Museum and Library, subject to by-laws to be framed by the Board.

Section III.

The Laboratory shall, for the time being, be and remain under the exclusive management of the Manager of the Institute.

Section IV.

Of Date 23rd September, 1870.

Honorary Members.

Whereas the rules of the Societies incorporated under the New Zealand Institute Act provide for the election of Honorary Members of such Societies; but inasmuch as such Honorary Members would not thereby become members of the New Zealand Institute, and whereas it is expedient to make provision for the election of Honorary Members of the New Zealand Institute, it is hereby declared—

1st. Each incorporated Society may, in the month of November next, nominate for election as Honorary Members of the New Zealand Institute three persons, and in the month of November in each succeeding year, one person, not residing in the colony.

2nd. The names, descriptions, and addresses of persons so nominated, together with the grounds on which their election as Honorary Members is recommended, shall be forthwith forwarded to the Manager of the New Zealand Institute, and shall by him be submitted to the Governors at the next succeeding meeting.

3rd. From the persons so nominated, the Governors may select in the first year not more than nine, and in each succeeding year not more than three, who shall from thenceforth be Honorary Members of the New Zealand Institute, provided that the total number of Honorary Members shall not exceed thirty.

LIST OF INCORPORATED SOCIETIES.

NAME OF SOCIETY.	DATE OF INCORPORATION.	
Wellington Philosophical Society	10th June,	1868.
Auckland Institute	10th June,	1868.
Philosophical Institute of Canterbury	22nd October,	1868.
Otago Institute	18th October,	1869.
Westland Institute	21st December,	1874.
Hawke's Bay Philosophical Institute	31st March,	1875.
Southland Institute	21st July,	1880.
Nelson Philosophical Society	20th December,	1883.

OFFICERS OF INCORPORATED SOCIETIES, AND EXTRACTS FROM THE RULES.

WELLINGTON PHILOSOPHICAL SOCIETY.

Office-bearers for 1886.—*President*—James Hector, M.D., C.M.G., F.R.S.; *Vice-presidents*—F. B. Hutchinson, M.R.C.S., W. T. L. Travers, F.L.S.; *Council*—Martin Chapman, Hon. G. R. Johnson, M.L.C., W. M. Maskell, F.M.S., A. de B. Brandon, jun., Charles Hulke, F.C.S., A. K. Newman, M.B., M.R.C.P., R. Govett; *Secretary and Treasurer*—R. B. Gore; *Auditor*—W. E. Vaux.

Extracts from the Rules of the Wellington Philosophical Society.

5. Every member shall contribute annually to the funds of the Society the sum of one guinea.

6. The annual contribution shall be due on the first day of January in each year.

7. The sum of ten pounds may be paid at any time as a composition for life of the ordinary annual payment.

14. The time and place of the General Meetings of members of the Society shall be fixed by the Council and duly announced by the Secretary.

AUCKLAND INSTITUTE.

Office-bearers for 1886:—*President*—Professor F. D. Brown, B.Sc.; *Vice-presidents*—J. A. Pond, H. G. Seth Smith; *Council*—J. Baber, C.E., C. Cooper, Hon. Colonel Haultain, E. A. Mackechnie, J. Martin, F.G.S., J. M. Moore, M.D., T. Peacock, M.H.R., Rev. A. G. Purchas, M.R.C.S.E., S. P. Smith, F.R.G.S., J. Stewart, C.E., Professor A. P. Thomas, F.L.S.; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S., F.Z.S.; *Auditor*—J. Reid.

Extract from the Rules of the Auckland Institute.

1. Any person desiring to become a member of the Institute shall be proposed in writing by two members, and shall be ballotted for at the next meeting of the Council.

4. New members on election to pay one guinea entrance-fee, in addition to the annual subscription of one guinea, the annual subscriptions being payable in advance on the first day of April for the then current year.

5. Members may at any time become life-members by one payment of ten pounds ten shillings, in lieu of future annual subscriptions.

10. Annual General Meeting of the Society on the third Monday of February in each year. Ordinary Business Meetings are called by the Council from time to time.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

OFFICE-BEARERS FOR 1886.—*President*—A. D. Dobson; *Vice-presidents*—W. H. Symes, M.D., and Geo. Hogben, M.A.; *Hon. Treasurer*—H. R. Webb; *Hon. Secretary*—Charles Chilton, M.A.; *Hon. Auditor*—C. R. Blakiston; *Council*—Professors Hutton and Haslam, Messrs. C. E. Bevan, Brown, R. W. Fereday, T. Cook, S. Hurst, Seager.

Extracts from the Rules of the Philosophical Institute of Canterbury.

21. The Ordinary Meetings of the Institute shall be held on the first Thursday of each month during the months from March to November inclusive.

35. Members of the Institute shall pay one guinea annually as a subscription to the funds of the Institute. The subscription shall be due on the first of November in every year. Any member whose subscription shall be twelve months in arrear shall cease to be a member of the Institute, but he may be restored by the Council if it sees fit.

37. Members may compound for all annual subscriptions of the current and future years by paying ten guineas.

OTAGO INSTITUTE.

OFFICE-BEARERS FOR 1886.—*President*—Professor Parker; *Vice-presidents*—Dr. Hockin and Mr. G. M. Thomson; *Honorary Secretary*—Professor Scott; *Honorary Treasurer*—Mr. J. C. Thomson; *Council*—Alexander Wilson, M.A., Dr. Petrie, M.A., D. Colquhoun, M.D., F. R. Chapman, J. De Zouche, M.D., H. Skey; *Auditor*—D. Brent, M.A.

Extracts from the Constitution and Rules of the Otago Institute.

2. Any person desiring to join the Society may be elected by ballot, on being proposed in writing at any meeting of the Council or Society by two members, and on payment of the annual subscription of one guinea for the year then current.

5. Members may at any time become life-members by one payment of ten pounds and ten shillings in lieu of future annual subscriptions.

8. An Annual General Meeting of the members of the Society shall be held in January in each year, at which meeting not less than ten members must be present, otherwise the meeting shall be adjourned by the members present from time to time, until the requisite number of members is present.

(5.) The session of the Otago Institute shall be during the winter months, from May to October, both inclusive.

WESTLAND INSTITUTE.

OFFICE-BEARERS FOR 1886.—*President*—T. O. W. Croft; *Vice-president*—J. P. Will; *Treasurer*—C. F. A. Broad; *Committee*—W. A. Spence, Wm. Kenny, Jno. Nicholson, H. L. Robinson, A. H. King, C. Horgan, E. B. Sammons, J. W. Souter, G. Clarkson, Captain Bignell, James Park, Rev. H. Gould; *Secretary*—Richard Hilldrup.

Extracts from the Rules of the Westland Institute.

3. The Institute shall consist:—(1) Of life-members, *i.e.*, persons who have at any one time made a donation to the Institute of ten pounds ten shillings or upwards; or persons who, in reward of special services rendered to the Institute, have been unanimously elected as such by the Committee or at the general half-yearly meeting. (2) Of members who pay two pounds two shillings each year. (3) Of members paying smaller sums, not less than ten shillings.

5. The Institute shall hold a half-yearly meeting on the third Monday in the months of December and June.

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

OFFICE-BEARERS FOR 1886.—*President*—W. I. Spencer; *Vice-president*—J. Goodall, M.I.C.E.; *Council*—H. Hill, F. W. C. Sturm, S. Locke, N. Heath, J. T. Carr, A. P. Sheath; *Hon. Secretary and Curator*—A. Hamilton; *Hon. Treasurer*—J. N. Bowerman; *Auditor*—T. K. Newton.

Extracts from the Rules of the Hawke's Bay Philosophical Institute.

3. The annual subscription for each member shall be one guinea, payable in advance on the first day of January in every year.

4. Members may at any time become life-members by one payment of ten pounds ten shillings in lieu of future annual subscriptions.

(4.) The session of the Hawke's Bay Philosophical Institute shall be during the winter months from May to October, both inclusive; and general meetings shall be held on the second Monday in each of those six months, at 8 p.m.

SOUTHLAND INSTITUTE.

OFFICE-BEARERS FOR 1886.—*President*—Dr. Galbraith; *Vice-president*—Ven. Archdeacon Stocker; *Council*—Messrs. Bailey, Scrutton, Mehaffey, Cuthbertson, and Dr. Closs; *Treasurer*—Mr. Robertson; *Secretary*—Mr. E. Webber.

NELSON PHILOSOPHICAL SOCIETY.

OFFICE-BEARERS FOR 1886.—*President*—A. S. Atkinson; *Vice-presidents*—The Bishop of Nelson and J. Meeson, B.A.; *Secretary*—Dr. Coleman; *Treasurer*—A. K. Somerville; *Council*—Dr. L. Boor, Dr. J. Hudson, J. Holloway, J. S. Browning, and W. S. Littlejohn; *Curator*—Dr. Hudson.

Extracts from the Rules of the Nelson Philosophical Society.

4. That members shall be elected by ballot.

6. That the annual subscription shall be one guinea.

7. That the sum of ten guineas may be paid in composition of the annual subscription.

16. That the meetings be held monthly.

23. The papers read before the Society shall be immediately delivered to the Secretary.

TRANSACTIONS.

TRANSACTIONS

OF THE

NEW ZEALAND INSTITUTE,

1885.

I.—MISCELLANEOUS.

Art. I.—*The Maori in Asia.*

By E. Tregear.

[*Read before the Philosophical Society, Wellington, 12th August,* 1885.]

One who is an authority on Philology (Dr. Latham), when commenting on the Polynesian language, says "The first thing which commands attention is its thorough insular or oceanic character."

It is this mistake, made by all the other European scientists also, which it is my endeavour to correct; so far from being insular, its every word is kindred to the speech of the mainland, and, far from being oceanic, it stretches from Iceland and the Isle of Man across the continents of Europe and Asia.

In reading this paper, I must consider the argument used in "The Aryan Maori" as being in the possession of my hearers. I have arrived at the conclusion, mainly by the evidence of language, that the Maori is a branch of that great race which conquered and occupied the major part of Europe, Persia, and India. Of the three divisions of language, the monosyllabic, the agglutinated, and the inflected, the Aryans have been supposed to possess the characteristic of an inflected grammar, while the Maori has been set down among the agglutinated group. But, however true it may be that the Aryan languages are now inflected, I think it can hardly be pretended that they were always thus; grammar is a mere matter of development, and the primitive tribes from whom we are all descended troubled themselves little with the intricacies of scholasticism; the "bare-limbed men with stone axes on their shoulders" who conquered Europe had not conquered the Greek grammar, nor had the victors over the Nagas of India evolved the "rules of external and internal Sandhi" to vex the soul of the student of Sanscrit. The Maori has crystallized his speech in that mode which the primitive Aryans used, perhaps 4,000, perhaps 6,000 years ago.

It may be said, perhaps, that I throw too much importance into the resemblances of words, and that the community of language is not the only conclusive proof of unity of race. But, each to his own department, it will be for the geologist, the anthropologist, and the general historian to deal with the question more fully—where I go outside the province of language I do so only in the briefest manner. But it is to language that the scientist looks for his most conclusive evidence of common descent. The measurement of skulls, the comparisons of religions, the groupings by shades of colour, would never have led to the certainty that the dusky Hindoo was brother to the fair Prussian, had not the testimony of language been decisive. A change of locality induces alteration in the lower animals far greater than any variety in the races of men; the pig, transported to South America, becomes in some cases red, in some black; it gets a thick fur, underneath which is wool, some even have solid hoofs; the number of the vertebræ differs in different species, and the wild hog has six incisor teeth in the upper jaw, and six in the lower, while the tame animal has only three. According to M. de Quatrefages there is a race of cattle in Piacentino which have fourteen pairs of ribs instead of thirteen. Dr. Draper affirms that darkness or fairness of skin depends on the manner in which the liver performs its duties, and that colour has no reference to race. The ravages made by even half a century of degradation, are well shown by Brace in his manual of Ethnology: "Malacca," says Dr. Yvan, "has about 30,000 inhabitants. This population is composed of Portuguese, Dutch, English, and Chinese. Among the inhabitants of European origin, the Portuguese are the most numerous. They are, for the most part, descendants of the ancient conquerors of Malaisia. Their fathers were the companions of Vasco di Gama and Albuquerque, but like the monuments that their ancestors raised, and which cover the soil of their ruins, they also have been injured by degradation and age." After mentioning that they are lower in every way than the Malay, that even their features have put on an Ethiopian type, he resumes: "The majority bear illustrious names, and they are ignorant who were their fathers, and what ray of the past pierces their obscurity. In the space of half a century, perhaps, religion, morals, traditions, written transmission of thought, are effaced from their remembrance."

The Maoris have had no such fall; in their religion, their language, their customs, they seem simply not to have advanced, but among them we stand as we should have stood among our own ancestors in the age of polished stone weapons, the Neolithic period. I will, then, revert to the chief line of scientific comparison, that of language, and will compare Maori with tongues now spoken. First, the Aryan of Persia and Hindustan. Hindustani is scarcely to be called a language; it is a compound of

three great languages—Sanscrit, Persian, and Arabic. Of the Maori agreement with older Sanscrit I gave many examples in the "Aryan Maori"—when a dictionary (which I have ordered from England) arrives, I shall be able to show the older forms at a greater length. The words I shall call Sanscrit are those written in the Hindu dictionary in Sanscrit characters, the Persian being written in Persian. The Arabic is a Semitic tongue, and I do not understand it. Let it be remembered that probably the Hindu and the Maori languages have been flowing apart in two distinct streams for over 4,000 years, and I think the following examples will be thought to be very strange coincidences indeed.

In showing these comparisons I must remind my listeners that *ng* and *k* are interchangeable, that *r* and *l* are interchangeable, *r* and *d*, *p* and *b*, and that the Maori language insists on a vowel following a consonant, thus *plu* would be *poru* or *puru*. English instances of the interchange of *r* and *l* are—Prince Harry into Prince Hal, Sarum into Salisbury, &c. The *ng* into the *k* sound is finely shown in the Latin—*tango* becoming *tactus; pingo, pictus*, &c., so that all these changes have Aryan features. A good example of *r* to *d* is the Maori *ra*, a day, changes to the Danish *dag*, the German *tag*, the English *day*—the German and Danish interchange of *d* to *t* being equal to that of Sanscrit to Maori, as will be shown by examples.

HINDUSTANI.

SANSCRIT.	MAORI.
Ukhar, to root up	*Hauhake*, to root up crop
ukhar, to extirpate	*ukupapa*, to finish, consume
apas, fraternity	*apo*, to gather, together
apas, fraternity	*apu*, a company of labourers
utar, to cross, low water	*uta*, the land, coast
utar, the fare (ferry)	*utu*, the price paid
utarna, to transport, carry	*uta*, to load a vessel
atur, to hurry	*atea*, to clear out of the way *atute*, to jostle
var, a day	*wa*, a division of time
achun, a teacher	*ako*, to teach or learn
ar, contention, dispute	*arita*, irascible
as, to desire, have children	*ai*, to procreate
akirat, defamation	*akiri*, to reject
ankh, the eye	*anga*, to look
agda, firm, strong	*akuaku*, firm, strong
age, before, beyond	*ake*, before, onwards
age, to press forward	*aki-aki*, to urge on
alang, the way, direction	*ara*, the path
anokha, singular, rare	*anake*, only
ani, the point (of an arrow)	*ane-ane*, sharp

SANSCRIT.	MAORI.
bat, to speak, question	*patai*, to question
bak, to speak	*pakiki*, to question *pakiwaha*, boastful
bal, a baby	*parare*, to bawl
bal, the hair	*pare*, a band for the hair
bal, a sprout	*pariri*, a sprout
ban, an arrow	*pana*, to thrust away *panga*, to throw
ban, form, colour	*pani*, to paint
bao, wind, flatulence	*pahu*, to burst, explode
bach, a root	*pakiaka*, a root
burra, seed	*pura-pura*, seed
Barahi, the goddess of eruptive diseases	*para*, affected with pimples
baru, jungle grass	*paru*, to thatch
birash, to separate	*pirara*, to be separated
barah, a homestead	*para*, to fell bush, to clear
bara, cakes	*parare*, food
bara, worthy, eminent	*para*, bravery, spirit
barhna, to increase, expand	*purena*, to run over
basula, an adze	*pahore*, scraped off
bagla, a wading bird	*pakura*, a swamp hen (pukeko)
bala, a beam	*para*, a tree cut in halves down the middle
bulbula, to bubble	*pu-pu*, to bubble up, boil
bahu, a wife (from *vah* to carry)	*wahine*, a woman, wife
bhoj, to eat	*po-poa*, sacred food
bhor, the dawn	*puao*, the dawn
bhuk, the stomach	*puku*, the stomach
bhushan, jewels, embellishment	*puhi-puhi*, feathers or ornament for the hair *puiaki*, treasure
bhuka, longing, fond	*puku*, the affections *puka*, jealous
bhuka, hungry	*puku*, without food
bhola, artless, simple	*porahu*, awkward
bhunna, to burn	*pahunu*, to burn
bhae, to fear	*pairi*, afraid
bhapara, deceit	*paparua*, double
bhuchkana, to scare	*pukana*, to stare wildly
bhurkhas, splinters	*piraka*, firewood
bhirai, contact	*piri*, to come close
bhirai, to fight	*pi-piri*, to join battle
bhagana, to rout	*pakanga*, hostilities
bhaggi, flight	*pake-pake*, to put to flight *paketu*, to clear off
bika, crooked	*peka*, to branch, turn aside

SANSCRIT.	MAORI.
ghin, disgust, aversion	*kino*, bad *keno-keno*, stinking, offensive
ghuggu, an owl	*kokou*, an owl
ghan, clouds	*konga*, cloudy
ghi, butter	*kinaki*, a relish
gabbha, bedding	*kapi*, to be covered
gatta, a cork, plug	*kati*, shut, closed
gathi, a small bundle	*ka-kati*, to tie in bundles
garra, reddish	*kura*, red
gal, the throat	*koro-koro*, the throat
gulal, red powder	*kura*, red
gobar, cow-dung used for plastering the floor	*kaupa-pa*, a floor
gobar, a deity over cattle	*kaupa-pa*, a wise man, oracle
gopiya, a sling (used to drive away cattle)	*kopere*, a sling
gora, fair, white	*korapu*, to shine *korako*, albino
gol, a channel	*korou*, a channel
gol, round, annular	*koru*, looped
khal, a hide	*kiri*, a hide
khad, to dig	*kari*, to dig for
kyari, a garden bed	*keri*, to dig
ket, a comet	*kotiri*, a meteor
khas, a load	*kawe*, to carry
kya, what ?	*kia*, when ?
kat, to cut	*koti*, to cut
kaj, a feast, dinner	*kai*, food
kakatua, crested parrot (cockatoo)	*kaka*, a parrot
kam, skill, dexterity	*ka-kama*, quick, nimble
kan, to say bitter things	*kanga*, to curse
kachcha, green	*kakariki*, green
kapkapi, to tremble, shake	*kapekapeta*, to flutter, writhe
karva, bitter	*kawa*, bitter
kus, a mattock	*ko*, a spade (a sort of)
Dhori, the bull	Maori graft-words, *tara*, &c.

This is useful as showing the change of *d* into *t*.

din, poor, a pauper	whaka-*tina*, to treat as a slave
daur, a string	*tau*, a string
dudhi, the breast (mother's)	whaka-*tete*, to milk
dhara, a robber	*tahae*, a thief
dhaga, a thread	*taka*, a thread
dahana, to burn the dead	*tanu*, to bury *tahu* (*tahuna*), to set on fire

(Referred to afterwards.)

dhava, a march, attack	*taua*, a war party

SANSCRIT.	MAORI.
dhur, far-off	*turehu*, indistinctly seen
dhura, a boundary	*turi*, a fence-post *turaha*, to keep away
dharalla, a swarm	*tararau*, to make a loud confused noise
dhakka, to push, shove	whaka-*taka*, to throw down
dhakka, to fall frequently	*tataka*, to fall off
dhan, riches, property (but especially cattle)	*tana*, his (possessive) *taonga*, property.
Compare (Lat.)	*pecu* and *pecunia*.
dhup, the sunshine, warmth	*tupu*, to glow, redness
dubdha, doubt	*tupua*, strange, uncertain
dabna, to be concealed	*tapanihi*, to go stealthily
dabak, to hide	*tapaki*, to cover
tao, to heat	*ta-tao*, a long while cooking *tao-puku*, cook (wrapt in leaves)
tujh, thine	*tau*, thine
tevar, eyesight	*tiwha*, to squint
tiya (and *tia*) a boundary mark	*tia*, to drive in posts or pegs *tia-roa*, straight side (as of a pa)
tiri! have mercy! save us!	*tiri*, offering to a deity
tangi, a hatchet	*toki*, an axe
tar tar, piece by piece	*tatau*, to count
tar tar, to tear to pieces	*ta-tau*, to attack
tat, darling	"*te tau o te ate*," darling of one's heart
tabar tor, one after the other	*tapa-tahi*, one by one
tara, a star	*tara*, to throw rays
tar, to strike	*ta*, to strike with a stick
taga, a thread	*taka*, a thread
taiki, an ear-ring	*taringa*, the ear *hei-tiki*, a pendent ornament (*hei*, to wear)
tur turi, a trumpet	*tetere*, a trumpet
tircha, oblique	*tiraha*, to lean
tari, chastisement	whaka-*tari*, expose to chastisement
tarera, a buoy	*tarewa*, a buoy, float
tallar, the belly	*tara-uma*, the chest
tui, lace	*kotui*, lace
thap, to thump	*tapa*, to pulverize soil
thakka, a heap	*taka*, a heap
thora, a few	*torutoru*, few
tel, oil	*tere*, to float *tere-tere*, to be liquid
tar, to go	*taha*, to pass by *taawhe*, go round a corner

SANSCRIT.	MAORI.
tital, cheating	*tito*, to invent, lie
hela, to shove, push	*hirau*, a paddle
hel, a basket of cow-dung	*hereumu*, a cooking-shed
hullar, a crowd	*hura-hura*, visitors
nata, kindred	*ngati*, a tribe, or relations
nichor, the end, termination	*neku-neku*, to decline (as the sun)
nain, the eye	*nana*, the eyebrow
nikki, small	*nohi-nohi*, small
lar, a line, row	*ra-ranga*, a row
lagu, adhering	*raka*, entangled
lapat, the flame	*ra-rapu*, to flash forth
lata, a creeper, vine	*rata*, a creeper, vine
latar, overwork, fatigue	*rata*, tame, quiet
lank, a quantity	*ranga*, a shoal of fish
mohri, ends of a garment	*more-morenga*, the end
mae, a harrow	*maea*, to take up crop
mantar, a spell charm	*mata*, a charm
mok, silent, dumb	*moke-moke*, solitary, lonely
mukh, the mouth, face	*moka*, a muzzle
musli, the tap-root	*more*, the tap-root
mutthi, the hand	*matau*, the right hand
manana, to persuade	*manene*, importunate
moh, affection, love	*momo*, offspring
matkana, to ogle, wanton with the eyes	*matakana*, to be on the lookout, look shy
mota, fat	*matu*, fat
mat, understanding	*matau*, to know
matha, the forehead	*mata*, the face
mala, a necklace, rosary	*maro*, a girdle
pata, a sword	*patu*, a weapon
partala, a sword-belt	*patai*, a girdle
purya, an offering to a deity	*pure*, a ceremony of lifting tapu
pat, a screen, veil	*patu*, a wall-screen
	paka, dried
pakka, matured, cooked	*pakari*, matured
	vaku, dried, set
pott, to cover	*potae*, a hat, to cover
phari, a small shield	*pare*, to ward off
phut, an opening	*puta*, to pass through, a hole
pi, to love	*pie*, to desire earnestly
pet, the belly	*pito*, the navel
pallu, the border, edge	*parua*, edge of a bowl
pau, the grey dawn	*puao*, the dawn
pokhar, a pool	*poka*, a well, hole
paun, three-quarters	*punga*, an odd number
poe, *poya*, a pot-herb	*puwha*, sowthistle, greens
pat, a foot	*patere*, a dance

SANSCRIT.	MAORI.
patar, a dancing girl	*patere*, a dance
papar, cutaneous disease	*paipai*, cutaneous disease
pat, sound of breaking	*pato*, to crack *patate*, to crack
py-s, milk	*pi-pi*, to ooze, *pia*, gum of trees
pat, a platform	*patuka*, a raised food-store
chapar, hard soil	*tapa*, to pulverise soil
chapana, to chew or bite	*tapa*, chapped *tapahi*, to chop *tapa-tapahi*, cut in pieces
chup, silence, stillness	*tupo*, the cave where the bones of the dead were deposited *tupe*, to deprive of power by a charm
chippi, a patch	*tapi*, to patch
chat, instantly	*tata*, sudden
chat, a scratch or scar	*ta*, to tattoo
chitrana, to scatter, strew	*titari*, to strew
chatrao, scattering	*tatari*, to sift, strain
chut (in comp.), common, poor people	*tutua*, ignoble, low born
chahka, the pavement, floor	*takahi*, to trample on
cho, anger	*totohe*, to contend
cho, love, affection	*topu*, to pair *tohu*, to preserve
chir, milk (white)	*tea*, white (from *tete* to milk)
chekke, pudendum muliebre	*teke*, pudendum muliebre
chivar, tattered clothes	*ti-tiwha*, in patches
charcha, talk, report	*tutara*, gossip
jeli, a rake	*heru*, a comb
jai, to be born	*ai*, to procreate
jab, at the time, when	*apanoa*, until
jag, a feast, entertainment	*haka*, a dance song *hakari*, a feast
jani, a fainting fit	*anini*, giddy, dizzy
joru, a wife, consort	*hoa*, a wife or friend
joe, *jo*, a wife	*hoa*, a wife (Scotch *joe*, a sweet-heart)
jhari, a jar or pitcher	*hari*, to carry
sumeru, the holy mountain Meru; *sumeru*, the North Pole	*hume*, to bring to a point (the Maoris of old knew the point of stellar revolution)
suji, a needle, awl	*uhi*, the tattooing needle
swargi, celestial, heavenly	*Hawaiki* (savaiki)
soka, frost-bitten crops	*huka*, a frost
sel, a spear	*here*, a spear
ragi, a singer	*rangi*, a song

SANSCRIT.	MAORI.
rang, to be melted	*rangitoto*, scoria
rae, a prince	*rae*, a headland, forehead; *rei*, a jewel; whaka-*rei*, canoe with carved figure-head, bust, and arms
rati, enjoyment, intercourse	*rata*, familiar, friendly
ris, anger	*ri-ri*, anger
rassi, a rope	*rahiri*, a rope
rala, mingling, union	*rara*, to go in shoals
rau, a host, swarm	*rau*, a hundred
ruhk, (Pali, *rukkho*) a tree	*rakau*, a tree
rukha, dry	*raki*, dry, dried up
raula, noise	*rara*, to roar
rauna, a noose	*tarona*, to strangle
ruha, old	*ruruhi*, an old woman; *ru-wahine*, an old woman

PERSIAN.

PERSIAN.	MAORI.
gor, a waste	*koraha*, a desert
pari, winged	*parirau*, a wing
ravan, expert, dexterous	*rawe*, excellent
ravan, flowing, liquid	*rewa*, to melt, float
ravangi, embarkation	*rawahi*, the other side of a river
roz, the day	*ra*, a day
rez, pouring, dripping	*re-re*, falling water
rez ish, running at the nose	compare (M.) *ihu*, the nose
charagah, grazing land	*tarake*, to clean the ground
chopa, boiled rice	*topa*, cook in a hangi
charkh, the celestial sphere	*taka*, on all sides, all round
langar, a rope, a cloth	*ra-ranga*, to weave
pak, clear, fair	*paki*, fair, without rain
puch, empty	*pute*, a bag; *puta*, a hole
dar, a door; *duar*, a door	*ta-tau*, a door
daraz, extended	*tara*, rays, spines
darah, a crack, fissure	*tarahanga*, an indentation
taryai, the sea	*tai*, the sea
dam, breath, life	*tama*, a son; *tama-hine*, a daughter
parva, anxiety, concern	*pawera*, solicitous, anxiety
parhez, keeping aloof	*pare*, to fend off
pashm, hair, wool	*pahau*, the beard
derah, a tent	*tiraha*, a bundle; *tira*, a mast (the mast was originally a tent-pole), plain-dwellers

PERSIAN.	MAORI.
rah, the road	*ara*, the road *huarahi*, road
rasa, welcome	*rahui*, to welcome
rasai, power of mind	*rae*, the forehead
tudah, a mound	*toropuke*, a mound
tir, an arrow	*tiri*, to throw one by one
tez, sharp-pointed	*te-te*, the head of a spear *tei-tei*, the summit *tia*, to stick in
geshu, a ringlet	*kehu*, hair (in com.)
tab, penalty, forfeit	*tapu*
tabahi, destruction *tabar*, an axe	*tapahi*, to chop to pieces
tarash, to shave	*tarai*, to adze
tazi, recent, fresh	*tae*, to arrive
mom, soft, waxy	*momona*, fat, rich
mir, a chief	*mira-mira*, to give prominence to whaka-*mira-mira*, to treat with deference *mira*, to cherish
dur, remote, far off	*tara* (*korero tara*), a fable *turara*, spread out
doz, to sew	*tui*, to sew
khak, not at all	*kauaka*, dont!
khak, to be overcast	*kakarauri*, to be dusk
khan, a noble	*kanapu*, bright, shining (compare (Sk.) *rajah*, from *raj* to shine)
kham, green, unripe	*kaimata*, green, uncooked
khunak, cold	*kuiki*, cold *koangi*, cold *koanu*, cold
khuari, vileness, abjectness	*kuare*, ignorant, low
khuah, to desire	*kuika*, desire
khur, to eat	*kai*, to eat
khush, pleased, delighted	*koa*, joy, pleasure
khuni, a murderer	*konihi*, to murder by stealth
khuni dast, dysentery	*konao*, diarrhœa
dar, holding	*tau*, to hold
dar, a stake	*tau-hokai*, stake for nets
baz, a hawk	*paho*, soaring whako-*paho*, to soar
bahanah, a stratagem, excuse	*paheno*, to slip away, escape
baja, good, right	*pai*, good
agah, knowing, informed	*ako*, to learn or teach
danu, corn	*tanu*, to plant.

I will beg you to consider this as no mere idle list of words; many of them are full of history, and open strange doors into the past of our race. I will give a few instances well worthy of attention: In Maori the word "*kotaha*" has two meanings, one, that of "a sling," and the other, "part of a chief's head-dress." Very few men now living have seen the chiefs with their hair dressed in the old fashion—the *putiki*, *ngoungou*, &c., are not now used. The Maoris do not seem (at all events for a very long time) to have used the sling in warfare, and thus stand in marked contrast to many other Polynesian Islanders, with whom the sling is an effective and terrible weapon. Another Maori word for sling is *kopere*, and its Sanscrit equivalent is "*gopiya*," a sling used to drive away cattle—(*go*, the cow). The Maori word for a fillet, or band for the hair, is *pare*, so that *kopere*, a sling, was also a hair-band, like *kotaha*. But this word *pare*, a band for the hair, is derived from *pareho*, the head, and this *pareho* is only our English word "brow," the forehead. We see this word in two forms in Maori; the Scottish word *brae* means the brow of a hill, shortened in Maori into *rae*, the forehead, or a headland; again, it is lengthened out into *pareho*, the head. I was for some time puzzled to know the derivation of the (M.) word *korero*, to speak or talk. According to my theory of graft words, it should, by its prefix *ko*, have had originally something to do with "cow." I analysed the part "*rero*," with these results: Connected with *speech* is the word *a-rero*, the tongue, represented by the Polynesian *alelo* or *aledo*. In Sanscrit *lal* is to put out the tongue; in Greek *lalao* is to speak, and *eiro* to speak—these seemed cognate words, but still far from the Sanscrit word "*vach*," speech. Then, suddenly remembering that the vocative of *vach* was *vak*, I saw the connection with (Lat.) *vacca*, a cow. The Sanscrit *vach* means more than mere speech or language, it was personified as the Goddess of Speech. In the Atharva-veda we find—"That daughter of thine, Oh Kama, is called the cow, she whom sages denominate Vach," she is the mother of the Vedas, the fount of wisdom, "the melodious cow who milked forth sustenance and water." So there is some reason also why the Maoris should call speech "the cow's tongue," *korero*. Another word for speech in Maori also has the prefix *ko*, that is *koroki*—the latter part of this word (by change of *r* to *l*) is (Lat.) *loquor*, I speak, and (Gr.) *logos*, a discourse. Yet another and most interesting word, *reo*, speech or language, has its exact equivalent in the Greek *rheo*. *Rheo* meant to flow swiftly; as a river-word we find it in the Rhine, Rhone, &c.; in New Zealand we find it as *re-re*, a waterfall. But there was another meaning for *rheo*, that of speaking quickly, whence came *rhema*, a discourse, and *rhetoric*, the art of speaking. From the Anglo-Saxon form, *reord*, came our English verb *to read*; so that two English words, at

least (read and rhetoric), have Maori brotherhood, through *reo*, speech.

It is important to students to notice that the (Sk.) *dahana*, to burn the dead, seems to contain forms of two Maori words—*tahu*, to set on fire (passive, *tahuna*), and *tanu*, to bury. It will be historical evidence if these words can be traced—not only as to which branch of the Aryan race they approximate to most closely, but also as to time. The Persians do not burn their dead; it was an ancient reproach to them that they cast the bodies of their dead out into the highways and open fields for the beasts to devour. At the present day the Parsees, the purest descendants of the fire-worshippers, expose their dead to be devoured by the vultures on the terrible "Towers of Silence," at Bombay. The Hindus burn their dead, but they did not always do so; it is no part of the old Aryan creed. There are beautiful burial hymns in the Vedas; let me quote one verse:—

> "Approach thou now the lap of Earth, thy mother
> The wide-extending Earth, the ever-kindly;
> A maiden soft as wool to him who comes with gifts,
> She shall protect thee from destruction's bosom.
> Open thyself, O Earth, and press not heavily;
> Be easy of access and of approach to him;
> As mother with her robe her child,
> So do thou cover him, O Earth."

It will, of course, be asked, if there are such strange coincidences in language between the modern Hindustani, Persian, &c., and the Maori, is it not likely that the Maoris have very recently left Asia. I will not reiterate the philological argument used in "The Aryan Maori" to prove how pure and ancient is the sound of the Maori letters. One good proof is that of religion: that, even in the graft-words, I have been unable to trace any reference to the Hindu Trinities, or to any distinction of caste, &c. There was no kingly institution; they were governed by the patriarchal elders of families, and men who had gained nobility as leaders in war. I have traced their word "*ariki*" in every Aryan tongue. In Gaelic it is *ardrigh*, high king; in Old Slavonic, *zary*; in Greek *arke*, chief, *archon*, a chief magistrate; in English, *arch*-angel, archdeacon (*arke-diaconos*), from the Greek. But to the Maori it did not mean so much; it meant a chief with some authority of deity, some spiritual essence not to be described except in many words.

Next, the Maoris had not learnt to kiss—the Hindus certainly know. The word "kiss" is very interesting by this new light on Maori etymology. The Sanscrit is *kuch*, a kiss; the Maori has got *kuku*, to pinch, nip (they pinch gently as a caress), and Williams's Dictionary gives as an example of *ku-ku*, "*Te kuku o tona manawa*—that which had fastened on her affections." Another Sanscrit word for kiss is "*niksh*," but this has such a

suspicious relation to *nas*, the nose (Fr., *nez*), that I believe the Maori nose-rubbing was what "*niksh*" meant originally.

The Maoris knew of no musical stringed instruments. The Hindu word *tar*, a string of a musical instrument (whence, guitar), is represented by (M.) *tau*, a string, a rope; but the music-meaning of *tau* was a song.

The New Zealanders not only do not seem to know the later Indian deities, but they do not know their demons. The Hindu *bhut* or *bhat*, a goblin dwelling in holes and graves, may have connection with (M.) *patu-paiarehe*, the Maori fairies (perhaps *paiarehe* is the Persian word *peri*, a fairy), but it is closely allied to *puta*, a hole; the Persian *ghoul*, a demon haunting graves, also being found in *koro-puta*, a hole—*ghoul*-word and *bhut*-word together—but the hole had as yet no ghostly habitant.

The Aryans had not learnt to discriminate (in words) between colours, when the Maoris left. The Sanscrit word *gaura*, yellow, really means shining, splendid; from *gaura* the Europeans named their metal gold—but (as *ghar*) it became the root of green. The Maoris kept the original word: *k* is older than *g*; *kura* older than *gaura*, but it was preserved by them as "red;" in fact, it is not any particular tint; *kura* is our own English word "colour."

Next, they had not learnt to drink *kava*. I think this a very important addition to my argument used in "The Aryan Maori," that the South Sea Aryans came as a little later wave of migration than the New Zealander. Almost everyone knows what *kava* is—the leaves of a tree chewed into pulp, and spat out into a vessel for use as an intoxicating beverage; it is much indulged in in the South Seas. But everyone is not aware that *kava* was anciently drunk in India as a sacred potation, and under the idea that the drunkenness was inspiration—hence the Sanscrit word for a poet is *kavi*, divinely inspirited, "in a fine frenzy rolling." There was enmity between the Kahvasakha, the kava-drinker, and those who drank the Soma, the later holy beverage of India.

But if we wish to find the meaning of *kava* we must go back to "cow" again. In Sanscrit, the genitive case of *gau*, the cow, is *gavas* (once *kau*, *kavas*), and *kava* means "chewing the cud." In a book called "South Sea Bubbles," whose titled author described the preparation of kava, he says that the pretty girls sitting around the *kava* bowl did not "*chew*," they did it so prettily that it should be called "*ruminate*." That is precisely the case, the word comes from that ruminating animal, the cow.

As an instance of cattle words in Maori, I will notice that the original meaning of *kowae*, cleft, divided, is *ko-wae*, "cow's foot," the cloven hoof. This, too, was once the meaning of the Sanscrit word *gabha*, split, divided; it was *ga-pad*, cow's foot.

But the main point against the late arrival of the Maoris from Asia is that many of their words have more direct connection with the Aryans of Europe, and even of the West of Europe, than with those of Asia. The Maori word *wai*, for water, is close to Sanscrit *var*, water, but closer far to the Celtic *wy*, water. Chambers's Ety. Dic. states that Celtic *wy*, water, is the word found in the rivers Wye, Conway, Medway, &c. The Maori *awa*, a river, is the Celtic *avon*, a river, (as the Avon, &c.,) and is exactly the Gothic *ahwa*, a river. If that most unlikely thing should have taken place, that, amid a multitude of sounds to be chosen, two races on opposite sides of the world selected the same two syllables to represent water, is it by chance that the Maori *tutei*, a spy, is the Greek *teuthen*, a spy? I can find no Asiatic resemblance yet so close to the Maori *ringa*, the hand and arm, as the Lithuanian *ranka*, the hand, and (Manx) *clingan*, the arm. The Maori *moana*, the sea, at first seems far from the Latin *mare*, the French *mer*, &c., but directly we know that the Celtic *mor* is the sea, we recognise the sister words *mo*, (*mo-ana*) *mor*, (Eng.) *mere*, (Lat.) *mare*, &c. This is proved by the word "island," *motu*. *Tu* means to stand, *mo-tu* is "standing in the sea." (A clump of trees is *motu*, from resemblance to an island.) We have the word in our own Aryan tongue: a *moated* grange is a house isolated, surrounded by water—(M.) *mote*, water. What is the real meaning of *Mo*? The wet? The tossing? I believe it means the Immense, the Great sea, another meaning to the Celtic *mor* or *mhor*, being big, huge. So if the original meaning of sea was "great" (*mo-ana* or *moa-na*), it may account for our huge extinct bird being called Moa, the great one.

I had long thought that the Maori word *ika*, a fish, a monster, also meant an island; that Te-ika-a-Maui, the fish of Maui, (the North Island of New Zealand,) really meant Maui's Island, but finding that our word island was originally *ig-land* (Anglo-Saxon *ig*, Scottish, *inch*,) I am led to believe that the story of Maui pulling up the big fish has only been made to accommodate a forgotten meaning of the old word.

I said in the "Aryan Maori" that I believed the Maoris once knew the pig by a name resembling "*porcus*," and one of the graft-words used was "*poka-poka*, making holes." The Latins had exactly the same word: *porca* means a sow, *porca* a ploughed field; originally, rooted up. *Rona*, our "woman in the moon" is the Latin deity *Luna*, the moon.

An important item in the comparison of languages is that of numerals. I shall not be able to go fully into the question of the great beauty and antiquity of the Maori figures; an evening would be taken up entirely by this one subject. I will only deal with a few of them. The Maori *rua*, two, is the (Lat.) *duo*, (Eng.) two, &c. *Toro*, three, is the Aryan three. *Wha*, four, (pronounced like "fa,") is the Teutonic *vier*, the English *four*.

The five, *rima*, is the old primitive way of counting on the fingers. *Tahi*, *rua*, *toru*, *wha*, *ringa*!—One, two, three, four, hand! *Ringa* and *rima*, (or rather *linga* and *lima*) are used in the Malay Archipelago as interchangeable words for hand. *Tekau*, the Maori ten, is the Greek *deka*, Welsh *deg*; and we see the change into the Teutonic form in another Maori word *tingahuru*, ten. *Tekau* and *tingahuru* are merely changes from *ng* to *k*, just as the Teutonic form *ten* changed into Greek *deka*. In numerals the manner of counting the twenties, thirties, &c., is important: here the Maori is again Aryan, and has one very close English resemblance. The English forty is made from *vier*, four; *tig*, ten; *viertig*, forty, or four tens. The Maori *wha*, four, *tekau* ten, *wha-tekau* forty; *viertig* and *wha-tekau* being as perfect in derivation as in sound.

Through the kindness of Dr. Hutchinson I am enabled to lay before you a photograph of the statue of Kamehameha, the King of the Sandwich Islands, in his national dress. The resemblance of the whole figure to that of an ancient Greek warrior is most surprising.

I must now intreat your patience while I compare the Maori with the European languages.

ABBREVIATIONS.

(M.E.) Middle English, (Fr.) French, (O.Sl.) Old Slavonic, (Lith.) Lithuanian, (Goth.) Gothic, (Gr.) Greek, (Lat.) Latin, (Scan.) Scandinavian, (Dan.) Danish, (Celt.) Celtic, (Ir.) Irish, (Ga.) Gaelic, (W.) Welsh, (Ice.) Icelandic, (A.S.) Anglo-Saxon, (Teut.) Teutonic, (M.) Maori.

MAORI.	
Ao, the air	(Lat.) *aura*, the air, *aer*, the air
aroha, love	(Gr.) *eros*, love
ae, yes	(Goth.) *jai*, yes, (Eng.) as in "Ay, ay, Sir"
ao, the world	(Goth.) *aiws*, the world
ako, to teach, learn	(Gr.) *agora*, a debating hall
angi, light breeze; *anene*, to blow gently	(Gr.) *anemos*, the wind
ara, to rise up	(Gr.) *oro*, to rouse, (Lat.) *oriri*, to rise up
au, smoke	(Gr.) *auo*, to burn
here-here, a slave	(Gr.) *helot*, a slave
huka, snow, ice	(Ice.) *jokull*, an icicle, (Ir.) *aigh*
hara, a sin	(Lat.) *erro*, to stray, err
hamuti, excrement	(M. Eng.) *mute*, to dung; (O. Fr.) *mutir* and *esmeut*
humu, the hip-bone	(Eng.) *ham*, (Ger.) *hamma*
hake-hake, the itch	(Ger.) *jüchen*, to itch, (Scotch) *yuck*

MAORI.	
hine, a girl	(Gr.) *inne*, a daughter, (Russ.) *jena*
hapara, to cut, slit *haporo*, to cut off	(Russ.) *sabla*, (Eng.) *sabre*
haupu, a heap	(W.) *hob*, a projection, lump
hapu, pregnant	(Goth.) *hof*, pregnant (heaved up)
hau, dew	(Ger.) *thau*, dew
here, to tie, confined	(Lat.) *sero*, to bind
here, to confine	(Eng.) *Hell*, (Goth.) *halja*
hira, a multitude	(Goth.) *hairda*, a herd
hua, an egg	(Gr.) *oa*, eggs
ika, the fish	(Gr.) *icthys*, (Lat.) *piscis*, (A.S.) *fisc*, (Ice.) *fiskr*, (Goth.) *fisks*, (Gael.) *iasg*.
iti, little	(Ice.) *litill*
kaki, the neck, throat	(Eng.) *gorge*, the throat. Compare *gargle*, *gurgle*, (O.Fr.) *gorgias*, a ruff, &c., (Gr.) *gargale*, the neck
koro-koro, the neck	(Lat.) *collum*, the neck
kopu, the belly	(Gr.) *kolpos*, the lap, bosom
kopmo, cut off abruptly	(Gr.) *kopto*, to cut off
ko-komo, a return feast	(Gr.) *komos*, a revel
korea, a small canoe	(Gael.) *curach*, a wicker boat, (Eng.) coracle
kapo, to take, snatch	(Lat.) *capio*, to take, (Gael.) *gabh*, to take
koke, a bottle or vessel *kokini*, a bottle or vessel	(Gael.) *cog*, a bowl, (Fr.) *coche*, a small boat, (Eng.) *cock*-boat
koparu, to mash	(Lat.) *copulo*, to join together
kokeke, mussels taken from the shell	(Fr.) *coque*, a shell, (Lat.) *concha*
kamaka, a stone	(Teut.) *car*, a stone, *meare*, a mark, boundary, (O. Slav.) *kamy*, a stone
kopako, back of the head	(W.) *cop*, a head, (Dutch) *kop*, (Lat.) *caput*
kape, to pick out	(W.) *gyp*, a beak, (Gr.) *gups*, a vulture
kau-kau, a spear	(A.S.) *gar*, a spear (from the "*gore*" of a horned beast)
kopae, a basket	(A.S.) *cypa*, a basket, (Eng.) a coop
kopaki, an envelope *kopare*, to shade the eyes	(Eng.) *cope*, a covering (root of "cap")
kararehe, a quadruped	(Gr.) *gryllos*, a pig

MAORI.	
karau, a comb	(Bret.) *krib*, a comb, (Gael.) *chir*, a comb
kai, food	(Gael.) *cluid*, food, (Gr.) *kao*, to eat, *kairos*, food
kohua, to cook, boil	(Lat.) *coquo*, to cook
kaikora, a vagabond	(Gr.) *geiros*, a stranger
kata, to rejoice	(Gr.) *getheo*, to be glad
koreto, to weep	(Gr.) *goeros*, wailing, weeping, (Scotch) *greet*, to weep
korenga, soft, boggy	(Ir.) *gleanir*, (Eng.) *glen*, a narrow valley
kohine, a girl	(Goth.) *kwino*, a woman, (Eng.) *quean*, a common woman
kanapu, shining	(Gr.) *ganos*, shining
katirehe, sore throat, quinsy	(Fr.) *goitre*, from (Lat.) *guttur*, the throat
kero, to wound, maim	(Gr.) *keiro*, to cut off, (Gr.) *kedo*, to injure
kino, bad	(Gr.) *kaunos*, bad
kiri, the skin	(Gr.) *chroi*, (dat.) the skin, (Fr.) *cuir*, leather
komau, to keep fire alight	(Gr.) *kauma*, flame
koru, coiled	(Gr.) *guros*, curved, round
kuao, young of animals	(Gr.) *kuo*, to be with young
karanga, to call	(Norwegian) *kalla*, (Eng.) call and clang
kau-ruki, smoke	(Dutch) *rook*, smoke, (Ger.) *rauch*, (Scottish) *reek*
muku, to wipe	(Ice.) *myki*, (Dan.) *mog*, (Eng.) *muck*, (Lat.) *mucus*
maia, brave, bold *maiangi*, raised up	(Goth.) *magan*, might, power
mangai, the mouth	(Fr.) *manger*, to eat, (Eng.) *munch*, to eat
mutu, to mutilate	(Lat.) *mutilo*, (Eng.) *mutilate*
mutu, to cut off short	(Eng.) *mute*, a person with the end of his tongue cut off
maunga, a mountain	(Lat.) *mons*, a mountain, (Gael.) *monadh*, (Eng.) *mound*
mene, to be assembled	(Lat.) *minare*, to drive cattle
monaroa, loitering	(Lat.) *mora*, to delay
maire, a song	(Gr.) *melos*, a song
momona, fat	(Goth.) *mammo*, flesh
moe, to sleep	(Gr.) *muo*, to close the eyes, *moimuao*, to close the eyes
mote, water	(Gr.) *mou*, water
maimoa, object of affection	(Gr.) *maimao*, to desire earnestly

MAORI.	
ngarara, a lizard	(Sk.) *naga*, a snake, (Gael.) *nathair*, a snake, (Goth.) *nadr*
ngou-ngou, to knot the hair	(Lat.) *gnodus*, a knot
noho, to dwell	(Gr.) *naio*, to dwell
hiore, the tail (*whiore*)	(Gr.) *oura*, the tail
ope, a troop, company	(Gr.) *obe*, a tribe
peka, branch of a stream	(Teut.) *beck*, a brook
piki, to climb	(Fr.) *pic*, a hill-top, (Eng.) *peak*, (Ger.) *spitz*
pai, good	(Celt.) *bain*, good, (Scotch) *bonny*, (Lat.) *bonus*
po-rangi, mad	(Sp.) *bobo*, a fool, (O. Fr.) *bobu*, stupid. Last part of word probably from same root as de-*ranged*
po-rotiti, a disc	(Lat.) *rota*, a wheel, (Eng.) *rotate*
piri, close	(Eng.) *peer*, to look closely, from (Ger.) *piren*, to draw the eyelids close
puruhi, a flea	(Rus.) *blocha*, (Dut.) *bloo*, (Ger.) *floh*
pere, to throw away, cast	(Lat.) *pello*, to drive away, (Eng.) to dis-*pel*
pipi, the young (as of birds)	(Gr.) *pippos*, a young bird, (Lat.) *pipare*, to peep, chirp
peka-peka, a bat	(Dan.) *bakke*, a bat, (Scotch) *bakke*
pori, the tribe	(Gr.) *polus*, the people, (Lat.) *po-pulus*
patiti, a hatchet	(O. Ger.) *parta*, and *barte*, an axe, (Eng.) *partisan* and *halberd*
pikau, to carry on the back	(A.S.) *bæc*, the back, and pick-a-back
panui, to proclaim	(Teut.) *ban*, a proclamation
patu, to beat	(Lat.) *batuo*, I beat, (Celt.) *bat*
pouto, to cut off	(Lat.) *puto*, to cut off, (Eng.) *am-putate*
pirangi, to love	(Gr.) *philo*, to love
poka, a hole	(Fr.) *poche*, a pocket, (O. Eng.) *poke*, a pocket, (Celt.) *bac*
puta, a hole	(Lat.) *puteus*, a well
pare, to ward off	(Lat.) *paro*, to ward off, (Eng.) *parry*
pane, the head	(W.) *pen*, the head
purena, to run over	(Lat.) *plenus*, full, (Gr.) *pleos*

MAORI.	
puna, a spring	(Scotch) *burn*, a stream, (Goth.) *brunna*, a spring
purakau, old man, old legend	(Gr.) *palaios*, ancient
pie, to call *pihe*, a song over the slain	(O. Slav.) *pye*, to sing
pine and *pipine*, close together	(Gr.) *bineo*, to unite
porohe, to gather in loops	(Gr.) *bolos*, to cast a net
pononga, a slave	(Gr.) *poneo*, to labour
reti, to ensnare	(Lat.) *rete*, a net
rau, a leaf	(Ger.) *laub*, a leaf
rawhi, to seize *rawe*, to snatch	(O.E.) *ravin*, to obtain by violence *raven*, a greedy bird
reke-reke, the heel	(Gr.) *lax*, the heel
rupe, to shake	(Gael.) *rub*, (W.) *rhwbio*, to rub, grind
ruaki, to vomit	(A.S.) *hræcan*, to vomit, (Ice.) *hrækja*, (Eng.) *retch*
rere, a waterfall	(Gr.) *rheo*, to flow as a torrent
roi, a tear	(O.H. Ger.) *ruz*, to weep, (Eng.) *rue*, to be sorry
ropa, a servant, slave	(O. Slav.) *rabo*, a servant
riki, little	(A.S.) *ling*, little
tia, frequent	(Gr.) *detha*, often
tiro, to look, survey	(Gr.) *delos*, apparent, manifest
tini, very many	(Gr.) *den*, a long time
tika, just, right	(Gr.) *dike*, just, right
tapau, a mat to lie on *tapaki*, mats	(Fr.) *tapis*, a carpet (Gr.) *tapes*, carpet
tinei, confused, unsettled	(Gr.) *dine*, a whirlpool, eddy
tatara, a rough mat	(Ice.) *tetur*, a torn garment, (Eng.) tatter
torohe, a marauding party	(Gr.) *dolops*, one who lies in wait
Tote, the god of sudden death *toto*, bloody	(Ger.) *todt*, dead
taureka-reka, a slave	(Gr.) *doulos*, a slave, (Celt.) *drugaire*, a drudge
tarehu, a goblin, fairy	(Scan.) *troll*, a goblin
taruke, a trap	(Ger.) *trugen*, to deceive
whaki-tauki, a proverb	(Goth.) *tugga*, the tongue
tango, to take, handle	(Lat.) *tango*, to touch, handle, (Goth.) *tekan*, to touch, take
tahu, to burn	(Gr.) *daos*, a torch
tahei, divided by a strip *tahuna*, furrowed	(Gr.) *daio*, to divide
toro-papa, to lie flat	(Lat.) *dor* (root of *dormio*), to sleep; cf. *dorsum*, the back

MAORI.	
tako, the gums, palate	(Gr.) *dakos*, a biting
tae, to be overcome *tai-apu*, to storm, assault	(Gr.) *dae*, a battle
takakau, the forearm (comp. of "cow" and "finger")	(Gr.) *daktulon*, the finger
tamau, to fasten	(Goth.) *tamjan*, to tame
tamoe, to repress	(Gr.) *damao*, to tame, subdue
tau, to lie at rest	(Gr.) *dauo*, to sleep
taitea, fearful, timid *taiatea*, nervous	(Gr.) *deido*, to fear
tae, exudation	(Gr.) *deisa*, moisture
ua, to rain	(Gr.) *huein*, to rain
ura, brown, (from *pura*, fire)	(Eng.) brown, from (A.S.) *brun*, from *byrnan*, to burn, from (Gr.) *pur*, fire.

But it is to our own language that Maori shows some of the strangest resemblances. The Teutonic roots of the English speech have close approximation to Maori. Here are some of the most curious. The (M.) *tokari*, to cut off, or notch, is our word, *dock*, to cut short, (W.) *tociaw*, to cut short. The (M.) *rara*, to roar, is *roar*. The (M.) *patu*, to beat, and *patu* a weapon, is (Eng.) *beat*, (root A.S. *bat*) and *bat*, as a cricket bat. (M.) *toi*, the toe, *is* toe. (M.) *poka*, to thrust, *is* (Eng.) poke. (M.) *karapiti*, to grapple, *is* grapple. (M.) *taka*, a thread, is (Eng.) to *tack* with a thread; (M.) *taka*, to turn, to veer, is (Eng.) tack, to go about; (M.) *takai*, to wind round and round, is (Eng.) tangle; (M.) *tangai*, the bark, is (Eng.) tan, (for dyeing,) and tannin. (M.) *hau*, to chop, is (Eng.) hew. (M.) *hopu-hopu*, to catch frequently, is (Eng.) hobble, a leg-fastening. (M.) *hiteki*, to hop, is (Eng.) hitch, to move by jerks. (M.) *hoanga*, a whetstone, is (Eng.) hone. (M.) *hoto*, a spade, is (Eng.) hoe. (M.) *hape*, bent, is (Eng.) hoop. (M.) *hake*, crooked, bent, is the (Eng.) hook. (M.) *hakui*, an old woman, (Eng.) hag. (M.) *hae*, to hate, is (Fr.) *häir*, and (Eng.) hate. (M.) *hoko*, to sell, is (Eng.) hawker, one who sells. (M.) *hoe*, to row, (Eng.) hoy, a boat. (M.) *hua*, to call, (Eng.) hue and cry. (M.) *tae*, to dye, *is* dye. (M.) *kiri*, the hide, is (Eng.) *curry*, to dress hides. (M.) *tope*, to cut off, is (Eng.) to *top*, as to top shoots of plants. (M.) *koripi*, to cut, is (Eng.) clip. (M.) *tapahi*, chapped or chopped, is (Eng.) chapped or chopped—the (M.) *tapa-tapahi*, cut in pieces, is only *chop-choppy*. The (M.) *kuri*, the dog (once a cattle-dog), is the Scotch *cooley* or *collie*, the cattle-dog. I only cease from fear of too utterly wearying you with examples, but hundreds of words, in both European and Asiatic Aryan languages, have similar brotherhood with Maori, and have been collected by me. These Maori words are not Anglo-Maori, they are to be found embalmed in old songs

and legends which have come down to us from days which date centuries before a European keel divided the Pacific.

Although, as I said in my introduction, I shall trespass on the ground of the geologist in the briefest manner, it would be wrong not to notice the evidence forced upon us by discoveries in New Zealand. Dr. Von Haast, F.R.S., says, in an article on the Moa-hunters, in which he judges from the polished stone implements found in the caves with the broken Moa bones, that the men who hunted the Moa lived ages ago: "Of course it is impossible to calculate this time by even hundreds of years, but as polished stone implements have been found in New Zealand buried in littoral beds, 15 feet below the surface, in undisturbed ground over which extensive forests are growing, containing trees of enormous size, there is no doubt that the use of polished stone implements dates far back in pre-historic times; I mean to say, to a period to which even the most obscure traditions of the aborigines do not reach." Mr. McKay, of the Geological Department, writing on the same subject, says: "Thus we are led to suppose that a people, prior to the advent of the present stock, were the exterminators of the Moa, always accepting as incontrovertible that the immigration alluded to did not take place 1,000 years earlier than stated in the said traditions on the subject. But in the meantime, accepting the 350 years, and treating 1,350 as a wild notion which the science of the subject has never yet dreamed of, let us see if the 350 years will be sufficient for the accomplishment of all that of necessity must be performed by these immigrants and their descendants." Another branch of science, Philology, will not, I feel assured, treat the early advent of the Maori as a "wild notion"; the trouble has been occasioned by the too great credence given by Maori scholars to the value of oral genealogies, &c. Sir George Grey has kindly allowed me to quote his authority for the following statement. He for years has believed that the Maoris must have inhabited New Zealand much longer than has been stated, the 350 years giving no possible space of time in which the enormous fortifications, &c., could have been erected, and the country populated densely in the North Island—in many cases, huge trees requiring centuries to gain their present bulk having grown out of the deserted defences. On leaving New Zealand for Africa, he took his Polynesian experiences of legend, &c., and compared them with those of other primitive races, such as the Kaffirs, Hottentots, &c., and came to the conclusion that the human memory did not retain legendary *personality* beyond the tenth or twelfth generation—that after the grandfather, the fourth, the fifth, the sixth ancestor, the *Man* was getting very shadowy, that back to the twelfth they were into myth, the *Man* had gone; in myth-land they could remember and sail away grandly, and even make no mistakes, in comparison with

mythical personages of other tribes. Speaking of skeletons found in the Moa caves, &c., Dr. Von Haast notices that they were all buried in a crouching position. It will be interesting to read a few instances of comparison with the Maori usages (known to us all) that occur in the work "Early Man in Britain," describing the Neolithic men. "The dead were buried in these tombs as they died, in a contracted or crouching posture. . . . For purposes of defence, they constructed camps, with well-engineered ramparts either of stone or earth, and fosses, sometimes as many as three or four ramparts being formed one above the other. The ramparts probably bore palisades. . . . The intercourse between the Neolithic tribes was greatly facilitated by the use of canoes, formed of the trunks of large trees, hollowed partly by the action of fire, and partly by the axe, and propelled by means of a broad paddle. . . . A flint arrow-head two inches long, and a 'wooden sword' have also been met with in the peat close by. . . . This kind of traffic is proved to have extended over enormous distances in the Neolithic age by the distribution of the axes made of nephrite or jade, a material as yet unknown in its native state in Britain or the Continent."

With these quotations, I conclude.

So many matters of interest grow up as one proceeds, so many paths are seen along which one would like to tread, that my great difficulty, in this article, has been to compress without leaving some important matter unnoticed. Many offers of kindly help are being made to me, and I feel sure that, before many years have passed, we shall, by study of this subject, have added to the scientific information of mankind, and written an interesting chapter in the history of the Colony.

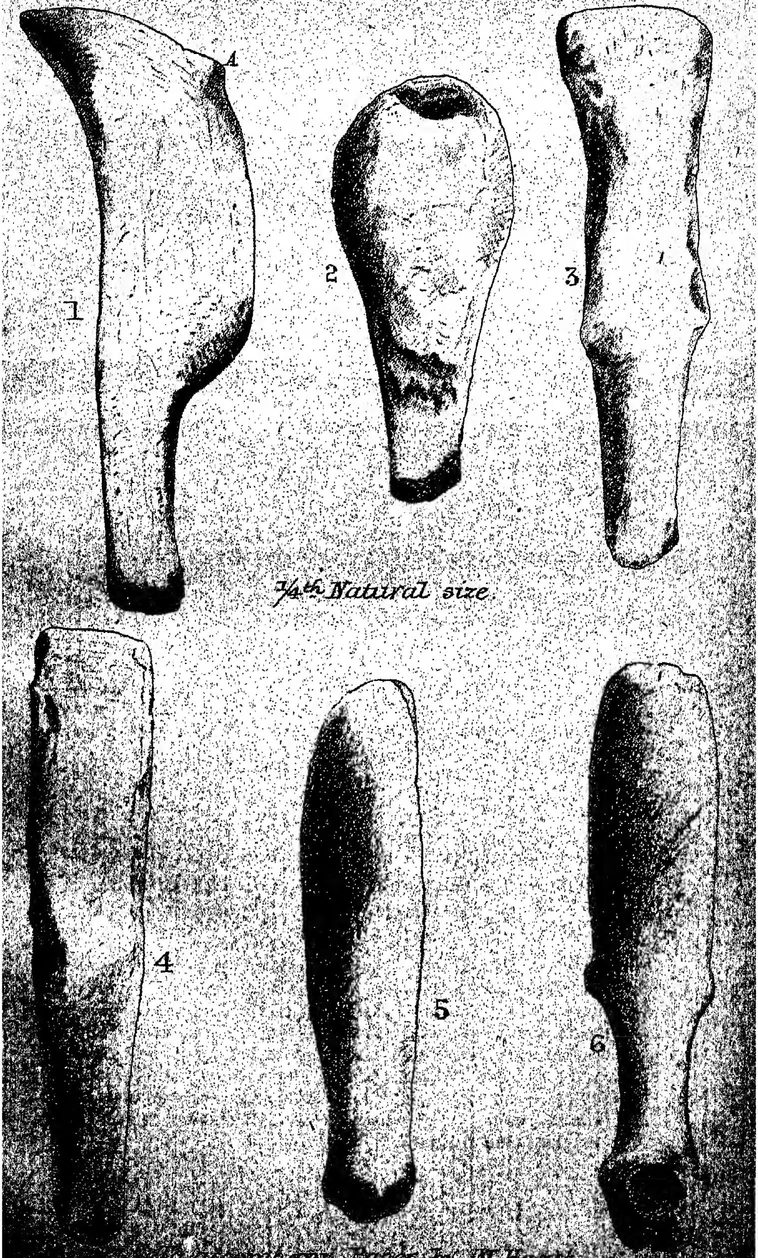
Art. II.—*On the Stone Weapons of the Moriori and the Maori.*

By Professor Julius von Haast, C.M.G., Ph.D., F.R.S.

[*Read before the Philosophical Institute of Canterbury, 26th November, 1885.*]

Plates I. and II.

For some time past I have been waiting in vain for some one more conversant with the history of the Morioris, those ancient inhabitants of the Chatham Islands, to describe fully their habits and customs, to note down their folk-lore, going back many generations, but chiefly to delineate the remains of their ancient handicraft preserved to us in burial places and spots where their dwellings were formerly situated. I was particularly anxious to have some account of those curious stone implements, known to us under the name of "*patu.*"



¼th Natural size.

Though the Canterbury Museum, owing to the liberality of Mr. E. R. Chudleigh and other friends from the Chatham Islands, possesses a fine series of these remarkable stone clubs, I should not have ventured to offer any remarks upon them, had I not lately received two unique stone weapons, found near the Hinds and near Oamaru, which (as I shall show in the sequel) have, in their primitive mode of workmanship and peculiar forms, some affinity with the "*patus*" of the Chatham islanders. Wishing to obtain as reliable an account as possible of the knowledge possessed by the Morioris of the present day of the method of manufacture and use of these remarkable stone weapons, I addressed myself to Mr. A. Shand, at present temporarily residing in New Zealand, for many years a settler in the Chatham Islands. He has the reputation of being not only a close observer, but also as one well acquainted with the history and traditions of the Morioris. That gentleman, in a letter dated Auckland, 30th September, has most obligingly given me a series of interesting notes which have afforded me an excellent insight into the whole subject. I think I can do no better than give at full length the contents of his letter in this communication. As to the names of the stone weapons and axes of the Morioris, and the mode of making them, Mr. Shand states that "*toki*" is the general term for all stone axes, including the lesser kind "*toki paneke*," and chisel, "*whao*" or "*puru-puru*," all of which were used for a considerable time after the discovery of the island by Captain Broughton, Nov. 23rd, 1791, in fact, until the advent of the Europeans (Sydney sealers and whalers), about 1830 and 1836, when all stone implements were laid aside or thrown away.

The stone axes and other implements were first roughed out by fracturing and chipping with other ones until the approximate shape was obtained. I may here add that the stone implements are made of lydian stone, aphanite, dioritic and basaltic rocks, for the greater part doubtless obtained on the Chatham Islands, though there are some specimens in the Canterbury Museum, received from that locality, of chert and of some other material which appear to have been imported from New Zealand.

After the approximate shape had been given to these stone axes, the Morioris used grindstones, "*hoanga*." These were made of a coarse sandstone, generally found on the sea coast at various places. They had generally a flat surface, were otherwise somewhat round, and varied in size from 7 inches to 12 inches on the average. This "*hoanga*" was placed flat on the ground, and the implement ground by rubbing it to and fro thereon with water. Numbers of these "*hoangas*" are to be seen at the islands, easily recognisable by the hollow in the centre, shaped like a saucer, a sign of their frequent use. Mr.

Shand observes that he need scarcely remark that the operation was tedious in the extreme; and one can easily see that such was the case by the examples of ill-ground axes, especially some of the smaller ones with round shoulders, "*uma*," unreduced, like an ill-ground European axe. On the other hand, however, there were a number of really beautifully finished axes, "*toki*," that must have taken an infinite amount of time and skill to get into such a perfect shape.

There are many unfinished axes lying about at the Chathams in the rough state, evidently intended to be ground, but afterwards thrown away. When not using them, the owner generally hid his "*tokis*" to avoid their being stolen. Now and again a number so buried are discovered in ploughing, or in digging up old places of residence. Mr. Shand observes that he has never seen, in fact doubts the existence of, any of the "*toki-titaha*" or large axes used by the Maoris, and common also to New Guinea, used for chopping the top and bottom edges of a cut, the ordinary form being used to cut out the chip by chipping sideways like an adze. It may be of interest, Mr. Shand continues, to state that the mode of making and tying a handle on to the "*toki*" or large stone axe was identical with that of the Maoris, of which race the Chatham islanders evidently formed a part in the original departure from Hawaiki. This is shown also by their traditions, legends, and the causes assigned for their leaving their so-called Hawaiki home.

The Morioris also used flint "*mata*," which they split into thin, irregular, wedge-like shapes, as knives, there being no volcanic glass ("*tuhua*") obtainable in any quantity, although a reef of it is known to exist under water at the south-east corner of the island at Manukau. The micaceous clay-slates or argillaceous schists, with layers of quartz, occurring on the northern coast of the main island—of which specimens were first brought to New Zealand by Mr. H. H. Travers in 1868, and which I described in Vol. I. of the Transactions*—were used for making the "*patus*," and were also employed in the same way as the "*mata*" (flint), though their edges cannot be made so sharp as that of the latter. Both are used with or without handles in cutting up grampus or any other variety of whale for food, the blubber of which was considered a great relish by the Morioris.

Entering upon the main subject of these notes, it appears that the Morioris, doubtless after looking in vain all over the island for a suitable material for the manufacture of their war weapons, which would take a fine polish, were at last compelled to have recourse to the argillaceous schist before referred to, to which the small layer of quartz, interlaminated with the argil-

* "Trans. N.Z. Inst.," vol. i., p. 128.

laceous layers, gave a considerable degree of hardness. From the traditions attached to these remarkable weapons, it is evident that a long time must have elapsed since they were manufactured, and some of them brought to such perfection, considering the material from which they were shaped.

It is clear that the same process of polishing the uniformly hard material, from which the Morioris made their "*tokis*" or stone axes, could not be applied to these war-clubs, and that the principal work of forming them consisted in the chipping process. When the proposed form was thus obtained, they proceeded to give the war-clubs some little polish, as much as was possible without removing the loose argillaceous or micaceous matter between the quartz layers. In some instances the layers were so very thin and intimately blended with the rest, that a far greater polish could be given to the material worked upon. In describing the different forms of their war-clubs, I shall return to this subject. Besides the large weapons made of nephrite (greenstone) to which exclusively the Maoris apply the term "*mere*," they also used stone weapons of similar form, manufactured from melaphyre, aphanite, and other fine-grained basic rocks, for which weapons the generic term "*okewa*" was used.

The Morioris, on the other hand, who did not possess any nephrite weapons or implements, had several names for the peculiar stone weapons they at one time used for offensive and defensive purposes.

They restricted the term "*okewa*" to a peculiar bill-hook shaped war-club, of which No. 1 is a reduced representation. These okewas range from 12 inches to 16 inches in length, with a breadth of 3½ inches to 4½ inches, and a thickness in the centre of an inch to an inch and a half. The weapon figured No. 1 is a remarkably well-worked specimen 15 inches long, 4 inches broad, and 1¼ inches thick; it is worked to as sharp a rounded edge as the nature of the material would allow. In this instance the micaceous schist is of a more uniform character, the quartz layers being very thin and inconspicuous. I may draw your attention to the sharp prominence at *A*, by which the edge is divided into two unequal parts, the upper portion above it sloping more rapidly backwards. We possess some of these *okewas* in the Canterbury Museum, which are only six inches long. They were either children's toys or attempts towards the learning of the manufacture of these implements. A second form (No. 2) has the shape of a club. It is named "*pohatu taharua*." The specimen is 10½ inches long, 4½ inches broad, and 1½ inches thick. The quartzose layers are much thicker, so that less finish could be given to it. Both sides are flat, the edges only being rounded off, except at the handle, where on one side the material has been so far removed that the curvature goes over the whole surface.

It is not nearly so well finished as the *okewa*, but it may be possible either that the owner of this stone weapon was not such an accomplished workman, or that the same attention was not bestowed upon any other form as upon the bill-hook shaped one, which, according to all appearance, was the most esteemed form.

We possess another specimen of this shape, about the same size, of which one side is perfectly flat, being formed of a quartz layer, whilst the other or rounded portion, owing to the thickness of the quartz layers, could only be partially finished. There are two other forms of the same material to which the term "*pohatu taharua*" is also to be applied. No. 3 is 14 inches long, 4 inches broad at the upper end, $2\frac{3}{4}$ inches in the middle, and $3\frac{1}{4}$ inches at the lower end of the shaft above the handle. It will thus be seen that towards the middle it curves inwards, and thus has a form different from any other, as it possesses four projecting points. It is flat and rather thin, having only a thickness of 1·1 inches at its thickest part. There is no attempt made to polish it except at the handle. It has altogether an unfinished appearance. No. 4, also a "*pohatu taharua*," resembles the foregoing form in shape, with this exception—that for the first 5 inches it is of nearly the same breadth, and only gradually diminishes in breadth till the handle is reached. It has, therefore, no prominent points. It is $15\frac{1}{2}$ inches long, 3 inches broad, and $\frac{3}{4}$ of an inch thick. The blade, as in the foregoing, is quite flat, being the natural division plane of the schist. Both edges are roughly chipped, but both the upper edge and the handle have received some slight polish, or perhaps, more correctly, have been rubbed down.

It appears that the term "*patu*" (to kill) was applied only to the *okewas*; in fact, Mr. Shand is convinced that it is very doubtful if it is a correct term at all, but rather one adopted by Europeans and retained as a term generally understood, being chiefly used in a descriptive sense.

According to Mr. Shand: "Manslaying was prohibited generations back, in the time and by the command of their ancestor Numuku and others, shortly after the arrival of their ancestors in their canoes Rangimata, Rangihona, and Oropuke, the last being commanded by Moe a Rauru, whose *hapu* or *iwi* were former antagonists of the people of the other canoes, and who found their way to the island some time after them. They fought on the island, and it was ordered by Numuku and others that fighting and manslaying should cease for ever; that in all future quarrels (a long pole, '*tupururi*,' about 8 feet to 10 feet long being used) the first blow causing blood to flow, if even by a slight abrasion of the skin, was to end the fight. This, however, did not prevent the person so injured from returning in like manner and seeking satisfaction at some other time for his

bleeding head, cracked skull, or barked skin, as the case might be."

As by the genealogy of the Morioris they have existed twenty-seven or twenty-eight generations on the island, it must have been a very long time ago that by that law of their ancestor Numuku all weapons such as *okewas*, *taos* (or spears), &c., were laid aside, the latter being placed on rests at their sacred places of sepulture. *Tuahu* were only produced on the occasion of "*tohinga tamariki*," a sort of baptismal ceremony; hence the making of *okewas* fell into desuetude, and that of any other warlike weapons known to their ancestors.

Concerning the stone implements used by the Maoris and their ancestors, I have already stated that they called all those made of nephrite (greenstone) *mere*, and the rest *okewa*. It is evident that the stone clubs, possessing the same form as the *mere* but made of hard black igneous rocks, are of a far more ancient date, though they have been worked with great care, and their form and polish are perfect. They have been found in such positions that there can be no doubt as to their great age. I was therefore much interested in obtaining two Maori stone implements, which are very different in form from those just alluded to, and which in many respects agree far more with the stone weapons of the Morioris than with those of the Maoris.

One of these, found during the draining of an extensive swamp at the Hinds, and presented to the Canterbury Museum by Mr. E. H. Dobson, is roughly made of greyish dolerite rock. It is 13½ inches long, 3 inches broad, and 1¼ inches thick in the centre. It has a resemblance to the *okewa* of the Morioris, in so far that only one side (different from the form of the *mere*) has been prepared for striking by being brought to a sharp edge, and that it has no hole through the handle for the purpose of passing a strap to be fastened to the wrist. The handle is also of a very primitive character. The process pursued in its manufacture appears to me identical with that of the Morioris, the implement being first chipped and afterwards roughly ground down, though at one spot an attempt has been made to give it a more perfect polish. This is the only weapon of the kind, viz., possessing a striking edge on one side only, that I have ever seen in New Zealand; and the position of the swamp, of enormous extent, is such that it may have been deposited therein during many generations past.

Another stone implement of very great interest to the ethnologist is one that was lately presented to the Canterbury Museum by Dr. de Lautour of Oamaru. It was obtained in deep ploughing at Windermere, on the Kakanui River, near Maheno, Oamaru. It is made of a similar micaceous schist to that of which the *okewa* (No. 1) of the Morioris is manufactured,

a schist which is a not uncommon rock in New Zealand. At the first glance we are struck not only by the peculiar form but also by the mode of manufacture, as it has been rubbed down in the same manner, and has thus the same somewhat flaky appearance, as the Chatham Islands weapons. What distinguishes it from the form of the *mere* are the prominent points above the handle, so that in this respect it resembles the weapon No. 3 from the Chatham Islands. Similar prominences also occur below the handle. Here a hole has been bored for the passing of a wrist-fastener. However, the whole weapon is very imperfect as to form and workmanship, and may also date back to a time when the manufacture of these weapons was in its infancy. The following are the dimensions of this remarkable stone weapon: Total length, 14½ inches; greatest breadth, 3½ inches; at prominent points above handle, 3¼ inches; greatest thickness, 1¼ inches.

Until further specimens of the same material and form are found of these remarkable New Zealand stone weapons, it would be premature to speculate upon the affinities between them and the stone weapons of the Morioris; but it seems evident to me that they date back to a time anterior to the discovery of nephrite at the West Coast, and its subsequent use in the manufacture of *meres*, which must have supplanted the inferior material used till that time.

Art. III.—*Notes on the Difference in Food Plants now used by Civilized Man as compared with those used in Prehistoric Times.*

By W. T. L. Travers, F.L.S.

[*Read before the Wellington Philosophical Society, 29th July, 1885.*]

There has been a good deal of learned discussion as to whether man was originally destined for a vegetarian or not, but however interesting this question may be in connection with his descent, it is one of no importance now in relation to his food, because his existing structure not only enables, but practically requires, him to extend his choice, in that respect, to the animal as well as to the vegetable kingdom. And he can, as a rule, do this with especial advantage, for by using a mixed diet he not only economises physiological labour, but also saves his excretory organs from a large amount of profitless work which would otherwise be thrown upon them.

But although a choice of food is thus given to him, the varying circumstances under which he exists on earth, determine, to a considerable extent, the direction in which that choice should be made. Within the tropics, for example, where any large consumption of flesh food would inevitably produce injurious

results, man is almost exclusively frugiverous, drawing nearly all he requires for food, as well as for shelter and clothing, from the plants which spring up in profusion around him. On the other hand, in the inhospitable circumpolar regions, (although the Esquimaux eats with relish the half-digested moss which he finds in the stomach of the reindeer,) he is compelled to counteract the rigour of the climate by a large consumption of flesh food, and especially of such as is rich in carbon.

We find, however, that independently of mere climatal considerations, in localities in which the conditions are such as to admit of vigorous plant growth, the extent to which man carries the utilisation of plant life for food and otherwise varies much, but that it certainly increases in direct ratio with his ascent in the scale of civilization; and it is my chief object in this paper to show the progress which has taken place in plant cultivation, during the gradual rise of man in civilization in those parts of Western Europe in which that subject has been investigated: because, in the first place, it is from thence that we have obtained the greater part of the plants, whether used for food or otherwise, which are cultivated amongst us; and because, in the next place, the climatal conditions which now obtain there bear a close resemblance to those of our Islands.

The earliest rude inhabitants of Western Europe of whom any traces have been discovered, are known as Paleolithic men. Their remains are usually found in caves and rock-shelters, associated with those of many animals now extinct, amongst which were the mammoth, the woolly rhinoceros, the reindeer, the stag, the lion, the hyæna, and the bear. Remote, however, as the period is from the present time, during which the earlier races of these ancient men existed, the remains left behind them and by their successors of that age, in the caves and rock-shelters which they inhabited, give, to use the words of Mr. Boyd Dawkins, "as vivid a picture of the human life of the period, as that revealed of Italian life in the first century by the buried cities of Pompeii and Herculaneum." These old floors of human occupation contain broken bones of animals killed in the chase, mingled with rude implements, weapons of bone and unpolished stone, and charcoal and burnt stones, which indicate the position of their hearths. And not alone do these remains point to the co-existence of man with the extinct mammalia to which I have referred, but they also afford clear evidence of the climatal conditions which obtained during the different portions of the Paleolithic period, and a clue to the characteristics of the race to which the men belonged. Mr. Boyd Dawkins, in speaking of later Paleolithic times, tells us that, in the caves which yield evidences of man's occupation, "flakes without number, rude stone-cutters, awls, lance-heads, hammers, saws made of

flint or of chert, rest *pêle-mêle* with bone needles, sculptured reindeer antlers, engraved stones, arrow-heads, harpoons and pointed bones, and with the broken remains of the animals which had been used as food—the reindeer, bison, horse, the ibex, the saiga antelope, and the musk sheep. In some cases the whole is compacted, by a calcareous cement, into a hard mass, fragments of which are to be seen in the principal museums of Europe. This strange accumulation of *débris* marks, beyond all doubt, the place where ancient hunters had feasted, and the broken bones and implements are merely the refuse cast aside. The reindeer formed by far the larger portion of the food, and must have lived in enormous herds in the centre of France. The severity of the climate at that time may be inferred by the presence of this animal, as well as by the accumulation of bones in the spots on which man had fixed his habitation. Indeed, had this not been the case, the decomposition of so much animal matter would have rendered the place uninhabitable even by the lowest savage."

These facts do indeed afford a vivid picture of the life conditions under which man existed at a time unquestionably separated from the present age by countless centuries, and that too, in parts of Europe which now sustain a rich and varied vegetation, and in which, except the horse, all the animals above referred to are now extinct and are replaced by herds of domesticated oxen and deer, by flocks of sheep and goats, and by numerous other animals maintained either for their profit or for their beauty.

It must be manifest that during this earlier period the human inhabitants could have derived as little of their nutriment from vegetable substances, as do the Esquimaux and Samoyeds of the present day, and that it is more than probable they devoured, with the same greedy relish as the former, the partly digested matter found in the stomachs of the ruminants upon the flesh of which they chiefly subsisted. Had they possessed any of the vegetable foods which, as we shall find in the sequel, were abundantly consumed by the Neolithic men by whom they were succeeded, some remnants of such food would unquestionably have been discovered amongst the *débris* of their feasts, by the scientific observers who so fully and closely examined those *débris*; and the complete absence of any such remnants, not only justifies us in assuming that they did not possess foods of the kinds referred to, but also serves to strengthen the view expressed above as to the nature of the contemporaneous climatal conditions.

A great advance in the vegetable food available for man in Western Europe is found to have taken place in Neolithic times. We have no means of estimating the length of the interval which separated even the later Paleolithic from that part of the Neolithic period to which I am about to refer, but the geological evidence alone indicates that it must have been enormous, that

evidence being supported by the fact that an extraordinary improvement had taken place in the climatal, and, indeed, in the physical conditions generally of the district in question, as indicated by the almost universal presence within it of an abundant and varied vegetation, and of a fauna analogous to that which now exists.

Our chief positive knowledge of the vegetable food resources of the Neolithic people of Western Europe has resulted from the discovery, made about thirty years ago, of the remains of the Swiss lake-dwellings, which led to those interesting investigations which have been recorded in the great work of Dr. Ferdinand Keller, President of the Antiquarian Society of Zurich.

This discovery was first brought under the notice of the Society at Zurich by Dr. Aeppli, of Ober Meilen, who reported that remains of human industry, likely to throw unexpected light on the primæval history of the earlier inhabitants of the country, had been brought to light, owing to the occurrence in the early part of that year of an unexampled drought, accompanied with such severe cold that the rivers were practically dried up. The result of this drought was to lower the water of the lake to such an extent, at a place where some reclamation works were going on, as to enable the workmen to excavate the land upon the shore immediately in front of their retaining wall, to a considerable depth below the ordinary water level. In making these excavations they found the heads of old piles *in situ*, and great numbers of stags' bones, mixed with implements and other relics of human occupation. This led to further investigations on the spot, and to similar investigations in other places, which were followed by the discovery of a large number of the settlements now known as lake-dwellings, and to the general results so elaborately detailed in Dr. Keller's great work. Great interest was at once excited amongst scientific inquirers throughout Europe, more especially as the very first settlement which was examined, namely, that of Meilen, was found to belong almost exclusively to the Neolithic age, for, with the exception of two metal objects, all the antiquities obtained there consisted of bone, iron, wood, stone or earthenware. In order that you may understand the conditions under which these antiquities have been so long preserved, I will endeavour to give you, as shortly as I can, an idea of the general structure of the lake-dwellings.

The settlement of which any assemblage of dwellings was composed was usually formed in a shallow part of the lake on the borders of which it was established. At a short distance from the shore a rectangular space was enclosed by a row of strong piles, which were often covered on the outside with wattling or hurdle work, intended either to lessen the splash of the water or to prevent injury to the piles by the impact of floating wood or of the canoes of the people. Within the inclosure thus formed,

rows of piles, generally in regular order, were driven at short distances from each other, the heads being brought to a general level with the outer boundary. Upon these piles a rough platform was constructed, often consisting of one or two layers of unbarked beams lying parallel to one another. Upon this platform rude houses were erected, the extent of the platform and the number of houses being of course regulated by the number of persons of which the settlement was composed. That portion of the platform which was within the area of each house was covered with clay mixed with gravel, firmly beaten down to form an even floor, and each house had a proper cooking-hearth. The houses appear to have been rectangular in form, their sides consisting of wattle and daub, and the roof thatched with straw or rushes. These platforms were always at some distance from the shore, with which they were connected by narrow bridges, formed also on piles. Whether the footways of these bridges were movable does not appear; but it is probable that this was the case, in order to prevent surprise on the part of an enemy desirous of attacking the settlement from the landward. It appears that all the refuse from these dwellings was thrown into the water below, through openings left in the platform for that purpose. The general conditions under which the earlier of these people appear to have lived is the more especially interesting to us, because, singularly enough, it is to the condition of the aboriginal New Zealanders, as described by Cook, that Dr. Keller compares the degree of civilization to which the inhabitants of the settlement of Meilen had apparently attained, as indicated by the remains discovered.

After extracting from "Hawkesworth's Voyages," Vol. III., page 395, a full account of the habits of life of the New Zealanders as there given, he proceeds to show the close resemblance to that account which is indicated by the remains found at Meilen and many other of the more ancient lake settlements. He then tells us, in regard to their domestic economy, (with reference particularly to the supply of vegetable food,) that in every lake-dwelling were to be found stones for bruising and grinding grain, or what are called corn-crushers and mealing-stones; that the very grain itself has been found at Meilen, Moosseedorf, and Wangen, nay, even the very loaves or cakes in their original form; and that we must therefore recognize the colonists as agriculturists, and see them advanced to that grade of civilization in which men have permanent abodes, and have secured for themselves some degree of social order. He remarks that the tilling of the ground must have been simple in the highest degree, and have consisted merely in tearing it up by means of inefficient tools made of stags' horns or crooked branches of trees, as is still done by some of the North American Indians, and was formerly done (as regards crooked pieces of wood and

other rude implements) by the Maoris; but he points out, nevertheless, that the products obtained from this rude cultivation were generally excellent—a fact known to ourselves as regards the Maoris—because, as a rule, they always used rich virgin soil, or soil that had long lain fallow, for growing their crops in.

Dr. Keller refers us to a treatise by Professor Heer on the plants used by the Lake-dwellers, for information as to their husbandry, and it is from that treatise, and from the investigations of Alphonse de Candolle and others, that I have prepared the following *résumé* of the subject. The remains of plants, from which Professor Heer drew his conclusions, were found lying in the lake mud below the sites of the various settlements, or buried under peat, several feet thick, formed since the settlements ceased to exist. They were found mixed with stones, fragments of pottery, domestic instruments, charcoal, ashes, and other unmistakable evidences of human occupation, and consisted of remains of cereals, of weeds usually associated with cornfields, of culinary vegetables, of fruits and berries, of nuts, of oil-producing and aromatic plants, of bast and fibrous plants, of plants used for dyeing, of mosses and ferns, of fungi for kindling fire, and of water and marsh plants. Of the plants used for food the cereals were evidently the most important, and consisted of a now extinct form of wheat called the "lake-dwelling wheat," and of a small-grained six-rowed barley, also extinct; whilst the spelt (which at present is one of the most important cereals,) and the oat did not appear until the Bronze age, and rye was entirely unknown. With the exception of a pea no culinary vegetable can certainly be mentioned as belonging to this period, but a small bean and a field lentil appear during the Bronze period. As to fruits, they appear to have been possessed of an abundance of crab apples, and in the later periods of a larger but still inferior species of apple, which may have been the result of cultivation; of a small and inferior description of pear, found associated with the relics of the Bronze period; of a plum closely allied to the bullace; of sloes, bird cherries, raspberries, blackberries, and strawberries, whilst it seems that they also used the fruits of the dog-rose and elder. Beech nuts were found in large quantities, and cakes, of the seed of the garden or field-poppy and carraway seeds, occurred amongst the remains of some of the more recent settlements.

Heer and de Candolle both remark that the Lake-dwellers could not have had any close connection with the people of Eastern Europe, otherwise they would, without doubt, have cultivated rye, and that the plants actually cultivated show that their chief intercourse must have been with the people of the Mediterranean basin. Every species of corn which they used had certainly come from that quarter, for it was identical with

those cultivated in Southern Italy, whilst the millets were similar to those cultivated in Egypt.

In connection with the character of the vegetation under notice, Professor Heer points out that it affords some clue to the determination of the age of the lake-dwellings, and by means of this and other evidence bearing on the question, he came to the conclusion that, whilst the most recent of those dwellings, namely those of the Bronze period, might be not less than 2,000 years old, the oldest might date back for thousands of years before the commencement of the Christian era. He also points out that those remains, which unquestionably have a very high antiquity, throw some light on the solution of the question whether the species of plants have undergone any change in historic time. As regards the wild plants he answers the question in the negative, (a conclusion concurred in by the late Mr. Darwin, for reasons given in detail in his work hereafter referred to,) but finds that the case is different with the cultivated plants, for that the greater number of those agree with no recent forms sufficiently to allow of their being classed together. He tells us that the small Celtic bean, the pea, the small lake-dwelling barley, the Egyptian and the small lake-dwelling wheat, and the two-rowed wheat or *emmer*, form peculiar and apparently extinct races, and he adds that man must, therefore, in course of time, have produced sorts which gave a more abundant yield, and have gradually supplanted the old varieties. Mr. Darwin sums up the investigations of Heer and others in passages which are to be found at pages 318 and 319 of the first volume of his great work on "Animals and Plants under Domestication," a work which, by the way, ought to be closely studied by every breeder of animals and cultivator of the soil.

From all this it will be seen that the great advance in civilization exhibited by even the earlier Neolithic over the latest Paleolithic inhabitants of Western Europe, may be assigned chiefly to their possession of an abundant supply of vegetable food, suitable, not only for man, but also for the maintenance of domesticated animals, of which, as Professor Rütemeyer of Basle tells us, they possessed several species.

I do not propose to deal with the long period which has intervened between the occupation of the lake-dwellings and the present time, which pertains entirely to the historic period, not only because it would stretch this paper to an inconvenient length, but because we shall be able more clearly and highly to appreciate the advance made in the character of our vegetable food during this interval, by a comparison of the inferior species possessed by even the later inhabitants of the lake-dwellings, with the rich produce now found in the cultivated fields and gardens of Western Europe. This is vividly brought to our

notice if we compare the list given by Heer of the vegetable foods used by the Lake-dwellers, with any well prepared gardener's catalogue of the fruits and vegetables now available for food, a comparison which cannot fail to satisfy us how much civilized man has already benefited, and may further expect to benefit, by the application of the principle of selection to the variability so especially characteristic of vegetable life, which has been so admirably discussed by Mr. Darwin in the work above referred to.

ART. IV.—*The Building Timbers of Auckland.*

By EDWARD BARTLEY, Architect.

[*Read before the Auckland Institute, 30th November*, 1885.]

SPECIMENS OF TIMBER TO ILLUSTRATE THE PAPER.

KAURI.—Four specimens: Red, white, black, and a soft kind from Tairua.
Piece of kauri joist destroyed by dry rot.
Piece of kauri destroyed by grubs.
Piece of window-sill from St. Andrew's Church, built in 1847.
RIMU.—Piece of 12 in. x ⅝ in. board, to show the difficulty in discriminating between sap and heart.
TOTARA.—Piece with the commencement of small spots of decay.
KAHIKATEA.—Piece of flooring completely destroyed by the grub.

THERE are only four kinds of New Zealand timbers used in Auckland for building purposes. I place them in the following order of merit: Kauri, rimu, totara, and last kahikatea. After touching on these various timbers, I propose to say a few words on seasoning and decay of timber. Permit me to remark that the statements are not gathered from hearsay, but from thirty years' experience in the building trade in Auckland. I have of late years taken down buildings that I either took part in erecting or saw erected; I have had, therefore, many opportunities of studying the durability and other characteristics of our Auckland-grown timbers.

First, the kauri (*Dammara australis*).—I have here specimens of four kinds of kauri: the red, white, black, and a soft kind, quite distinct in grain and quality from the others, which I will hereafter explain. The red kauri is the best general building timber; it is well adapted for heavy framework, beams, joists, and the like; it is close-grained, rather gummy, very durable, but is liable to cast and twist; it shrinks endways as well as in width. The shrinking endways is a great drawback to kauri, and more especially this kind. I have known a forty feet beam shrink 1½ inches in length. I have also known a weatherboard shrink ¾ of an inch in twenty feet, and most of us will remember ceiling mouldings and other joiners' work

shrinking so as to quite disfigure the building. This red kauri should only be used for beams or other framework, and not for mouldings or joiners' work. The next is the white kauri, a tough kind of timber; will bear a greater breaking strain than the red, but not so durable; I have seen it quite soft in a few years; it is a splendid timber for moulding and joiners' work. The shrinking endways is almost *nil*, if worked up after a fair amount of seasoning, neither will it cast. It is largely used by boat-builders on account of its readiness to bend. Black kauri is not very abundant, it comes from the west coast of the island, it is only fit for rough work, is heavy with gum, and the most durable of all; in fact, for fencing-posts or the like, I believe it would last as long as puriri. I need hardly say it is not fit for mouldings or joiners' work; it is so hard it would require very strong machinery to work it, and after being worked it would cast into all shapes. The last specimen of kauri (No. 4) is *the* timber for joiners' work and mouldings; there is a peculiar grain marking in this kind of kauri not to be found in any of the other specimens—this kind should only be used for mouldings and joiners' work. We have often heard it remarked that kauri is noted for its casting, twisting, and shrinking: well, this last kind of kauri will neither cast, twist, nor shrink endways. I have seen slight scantlings, say 3 in. by 3 in., 20 feet long, quite straight, after being exposed to the weather without any care. I have seen joiners' work made up out of this timber standing as well as cedar. I have already said it should only be used for joiners' work and mouldings, it is so light and soft; it should never be used for beams or heavy framework; but if this kind of kauri and the white only were used for joiners' work and mouldings, we should seldom hear of ruined ceilings, and twisted doors and sashes. This kind of kauri is only found in the Tairua District.

The next timber on my list is the rimu (*Dacrydium cupressinum*). It is known in the South Island as red pine. The rimu, I believe, grows in the South to a very large tree, but in this province the average size tree is two feet six inches to three feet diameter; it is a timber with a large proportion of sap-wood—a two-feet diameter log will have nine inches of sap-wood, leaving only six inches of heart, the heart not being very well defined. By this specimen of rimu (a board twelve inches wide) the difficulty in discriminating between sap and heart will be seen, even by an expert. There is a hard white gum, and frequently many shakes, near the heart, that renders this tree unfit for boards, but it answers well for scantlings, joists, and framework. The sap-wood, if exposed to weather or damp, will not last, but the heart is very durable. I have known rimu fences standing many years. Of course, with kauri so plentiful, we have not used much rimu; but at the rate the kauri is being cut, before many years we shall, I am sure, have to fall back on

the rimu. Picked heart of rimu is a very good furniture wood, and very suitable for church furniture.

Totara (*Podocarpus totara*) is the third timber of importance. It is largely used in the South for building purposes, but in Auckland we only know it as a good "pile" timber, and for that purpose it has not been equalled by either native or imported timbers. I have seen a "stringer" taken from Queen-street Wharf quite sound, after being under water twenty-eight years. Of course it was heart, the sap will not last; hence the folly of using round sticks for piles. All piles should be squared timber—all heart. It is at times specified for plates and window sills, with a view, I presume, that it will last longer than kauri. I think this is a mistake: my experience is that it will not last as long as the heart of red kauri. There is a small "rot" speck found in the heart of mature trees; I have here a specimen cut from a new plank with this kind of decay, still the totara must be classed as one of our most durable timbers.

The last, and the worst of our building timbers, is the kahikatea (*Podocarpus dacrydioides*). It will decay very soon, exposed to the weather or damp—in damp situations it will not certainly last longer than four years—and inside, or under cover, such as flooring, ceiling or lining, it is attacked by a small grub, completely destroying the inside of the scantling or board. I have here a specimen of kahikatea flooring destroyed by this grub; the destruction is so complete that I have known a floor rendered dangerous to walk on, the chairs having gone through in many places. I consider kahikatea is far inferior to all sap kauri. If used for rough lining, the perforations made by this grub will appear through scrim and paper of the room; in an instance that came under my notice, one kahikatea board had been fixed for rough lining, the remainder being sappy kauri: the board, scrim, and paper were quite destroyed, like a band nine inches wide, the remaining lining being quite sound. It is said that kahikatea grown on high ground grows better than that grown on low ground; but the greater portion, I should say nine-tenths, grows on flat swampy districts.

Seasoning and Decay of Timber.

The causes of decay are various, the worst being "dry rot"—a term giving a wrong idea of the nature or cause of the decay. I have here a specimen of heart kauri destroyed by "dry rot." It is covered with a fungus of extraordinary growth in Auckland. I have seen a plant measuring over five feet in diameter. Whether the fungus grows in consequence of the decay, or the decay is caused by the fungus, I am not quite clear; but I should rather think the fungus grows after the decay, and is not the cause of the decay. At any rate we know the first cause is by using unseasoned timber in unventilated positions, such as a

ground-floor without a space left for ventilation. Nearly if not all the ground-floors on the east side of Lower Queen-street are decaying with "dry rot." I have known 12 in. x 3 in. all heart kauri joists quite rotten in twelve years; the joists will break off in pieces from six inches to two or three feet long, and will be found flat on the ground, with square ends, the timber always breaking at right angles to the fibre of the wood. The kauri is also destroyed by a small grub, similar in some respects to the grub in the kahikatea, but with this difference: the grub in the kahikatea always bores with the fibre of the wood; the grub in the kauri will bore in any direction. I have here a sample of kauri bored with this grub. The sap-wood will be attacked first; but if found in a building, it will soon go right through, heart and sap falling a prey to it.

One great reason for kauri and other timber decaying is the constant use of young and unmatured timber. A mature kauri will be at least five feet diameter, showing well defined sap-wood of not more than three to four inches. Now, a large quantity of logs cut up in Auckland will not measure more than 2 feet 6 inches to 3 feet in diameter: this size log will have nine inches of sap-wood, leaving on a log 2 feet 6 inches only 12 inches of heart, and that soft and white. Next to using young timber is the constant use of unseasoned timber, and the practice of our mill-owners cutting down trees all the year round, and full of sap. I consider the trees should be "barked" at least six months before being fallen; the barking, of course, simply means cutting out a ring of bark, say four or six inches in width, close to the ground. Another plan, adopted in America, is to bore two holes right through the trunk, crossing each other in the middle of the tree; either or both are inexpensive operations, and should be tried by the mill-owners. As to the time of year for falling our New Zealand timbers, I consider, if barked or bored as I suggest, it would not matter a great deal. It will be seen at once that if we get rid of the sap or gum before falling we have overcome half the difficulty (if not more) experienced in seasoning. Hence the failure of artificial seasoning by the hot chamber, used a short time ago by some of the mills, the hot chamber simply baking the outside, leaving the sap and gum inside the plank. It is a fact known to all carpenters that kauri will season better in the rain and wind of winter than the hot sun of summer. Most of us know the effect of new kauri shingles on a tank of water: the gum and sap is washed out to such an extent by the rain, that the first water off the roof is like weak turpentine, and dark in colour. Then we have another cause of decay, consequent upon using unseasoned timber, that is the injudicious use of tar. It is right to tar a well-seasoned piece of timber, but utter folly to tar green timber, and all round, as we see repeatedly done in our buildings and wharves. I have known

a 4in. x 3in. plate of heart of kauri quite rotten in two years, solely on account of being tarred all round; the proof being that other plates in similar situations, and quite near, were quite sound. If the durability of timber is to be studied, it should be a rule not to paint or tar timber before being seasoned. That kauri will last, I have had many instances brought under my notice. Here is a portion of a window-sill taken from St. Andrew's Church, built in 1847; it will be found not the least impaired by thirty-six years' exposure to the weather. It was removed about two years ago. It was resting on a stone sill; the under side, it will be observed, has not been painted. Only one other instance: The two first grave fences in the Auckland Cemetery, erected thirty-three years ago, are still standing, and quite sound. The posts are of red kauri, and had been charred.

Art. V.—*A Description of the New Volcano in the Friendly Islands, near Tongatabu.*

By the Rev. S. W. Baker, Premier of Tonga.

[*Read before the Auckland Institute, 30th November*, 1885.]

On Sunday, October 11th, a slight shock of earthquake was felt about 10 a.m., and seeing we had had several shocks lately no particular notice was taken of it; but on Tuesday morning everybody's attention was directed to vast clouds of steam and smoke which were arising from the sea in a N.N.W. direction. On the preceding evening, at 11 p.m., many natives and others saw a vivid flash of light, and heard a report like thunder in the direction of the Huga Group of islands. On the matter being communicated to His Majesty, it was determined that the *Sandfly* should be sent to ascertain the bearings and extent of the volcano. Accordingly at noon the *Sandfly* left the Port of Nukualofa, having on board the Rev. S. W. Baker, the Premier, wife, and family; the Rev. J. B. Watkin and son, Dr. Buckland, and several other gentlemen; the Chief Tugi and several natives.

As the *Sandfly* neared the spot the scene was most magnificent, great volumes of steam, of carbonic and sulphurous gas, &c., being shot forth from many jets out of the sea, in a direct line of over two miles, extending in a northerly direction, to the height of 1,000 feet and more, then expanding themselves in all directions, in clouds of dazzling whiteness, and assuming the most fantastic shapes; sometimes presenting themselves as a mountain of wool, the tips of which were fringed with gold, caused by the rays of the setting sun, then again occasionally forming into a large cauliflower head of snowy whiteness,

backed by clouds of intense darkness formed of dust and ashes mixed with watery vapour, which the wind was carrying down for miles on the distant horizon. As the heavier matter kept continually falling, it gradually raised in height the new-made island; and as the cloud of pulverulent matter became thinner and thinner at its extremities, it assumed a light brown colour, forming clouds of volcanic dust which, no doubt, would be carried thousands of miles away, and repeat (if the theory be a correct one) the red sunsets of the volcanic action of last year in distant parts of the Pacific: and, strange to say, on the third and fourth evenings after the bursting out of the volcano, the same red sunsets as were seen last year were again noticed. The size of this mass of volcanic matter was immense; at one time it could not have been less than some thousands of feet at its base, and, piercing into the air to a great height, was distinctly seen thousands of feet above the clouds, and at one time a streak of sable colour passing across its centre made the whole mass present a most picturesque and grand sight. This great mass of accumulated gas, steam, and volcanic substance, was continually augmented by fresh explosions, bursting forth from three large and a number of minor jets. These jets, and especially the largest one, would suddenly rise forth like a solid wall of dark matter, in shape something similar to the three fingers of a man's hand, but always of a more or less conical form, and at times bearing a striking resemblance to the *Pinus pinaster* and *Pinus sylvester*, thus forcibly calling to mind the historical stone-pine of Pliny the Younger, mentioned in his letter to his friend, the historian Tacitus, in connection with the eruption of Mount Vesuvius in A.D. 79. The black clouds were small at first, and only appeared at considerable intervals, and gradually became larger and more frequent, 1½ to 3½ minutes expiring between each eruption, but still retaining their perpendicular character; and, after rising to a considerable height, their sides would sometimes fall quickly into the sea, causing clouds of steam to arise, whilst the centre would topple over and form itself into clouds of white gaseous and vapourous matter, presenting itself like a huge bunch of Prince of Wales' feathers; and what was most singular, many of these dark cauliflower eruptions had a spiral movement, always turning in the same direction from north round by the west to the south, and right against the wind. As the shades of evening approached and the night came on, the matter discharged by the volcano no longer appeared a huge mass of clouds of snowy whiteness but in the form of clouds of greyish matter and sooty blackness. We were somewhat disappointed in there being no signs of fire; many watched during a great part of the night, anxious to catch the first glimpse of the lurid flame, but were doomed to disappointment.

As the first light of morning appeared, we commenced to approach near the grand scenery of Nature's last wonder, having kept during the night at a distance of seven or eight miles. As daylight appeared, it was soon evident that the volcano had lost none of its activity, but instead of there being so many jets as on the previous night, several of them at the southern end of the line of jets had coalesced and formed themselves into one immense submarine chasm, and the rays of the rising sun shone upon the mass of vapoury matter and made it appear most beautifully golden. Having a good breeze behind us, we ventured to approach nearer than we would have otherwise done, and we were duly rewarded for our trouble, for we found that an island had already been formed some three to four miles in length, one in width, and attaining a height of about 40 feet at its highest part, which was around the crater on the N.W. side, and gradually shelving away from this until it lost itself in the sea. The length of the island was probably increased by a black mass, which we believe to be floating pumiceous matter; and it was also seen that a reef extended from it in a N.E. direction, from the surface of which various jets of steam were arising. The eruptions were now very rapid, and in one instance there were no less than four huge eruptions in three minutes. Although one of these large masses was ejected considerably over 1,000 feet, yet it only took 16 seconds in reaching that height; in fact, having timed many of the eruptions, we found that notwithstanding they went to a greater or less height they invariably took from 12 to 16 seconds. Some of these eruptions must have contained hundreds of tons of matter; and several times, just as the eruption reached its height, great spouts would be seen, which appeared to be huge waterspouts, and continued increasing until they were lost in the mass of gaseous vapour. These eruptions continued with very little interruption until 8.30 a.m., when to the surprise of everyone they suddenly ceased—and it is worthy of note that up to this moment there had been a constant column of smoke, &c., discharged from the volcano—and the strong wind, carrying away all the clouds of steam and gaseous matter, presented to our view the whole of the land, with a distinct crater formed on the S.E. end of the same, the back part of which was considerably higher than that at the water edge, which appeared to be only a foot or two. Dr. Buckland and others were of opinion that this was the exact moment when it emerged from being a submarine volcano to that of an ordinary volcano. As we were not more than one mile from it, we had a splendid and magnificent view, and we were led to judge that the crater from the size of the base of the column was at least two miles in circumference. Our attention was drawn to a white spot which appeared on the western slope of the crater, which, after careful examination with our glasses, we concluded was a bird which had tried to fly across

the volcano, and was suffocated by its fumes. So eagerly were we examining the crater that we neglected to notice the dangerous position in which we were, for, to our surprise, the vessel, notwithstanding the breeze we had, made but little headway, and for a few minutes it looked as if the current would draw us into the volcano. However, after several minutes of suspense the breeze increased, and we were soon out of danger, which was clearly manifested by the vessel shooting ahead as she drew out of the current; and it is fortunate for us that we escaped when we did, for the volcano commenced action shortly afterwards, and fragments of heated stone were hurled aloft to a great height and then fell, together with showers of cinders, splashing into the sea at some distance from the edge of the new-formed island. The matter ejected now seemed to be of a more solid nature than that which had been previously thrown out by the volcano. This, together with the fact that very little steam was now seen around its base, although over the surface of the island the steam still continued to rise in small jets, seems to be sufficient proof of the correctness of the conjecture formed by Dr. Buckland, that it had now passed from a submarine volcano to that of a volcanic island, and although no fire presented itself, yet it continued all day belching forth such solid matter, accompanied with clouds of gases; for, after the completion of the crater, the enormous upheavals of cinders, mud, and dust, &c., increased not only in rapidity, but also in height, ten occurring in twelve minutes; sometimes a second and third would arise before the first had fallen. This continued for about three-quarters of an hour, when the eruptions became less frequent, but increasing in height, towering aloft from 8,000 to 10,000 feet, or perhaps even considerably higher, and the light flocculent clouds of vapour, which separated themselves from the main mass and floated away in the air, presented a most enchanting spectacle, and between the eruptions the island was more or less visible. But to describe the various shapes which these eruptions of gaseous matter assumed would be impossible. It certainly is one of the grandest efforts that even volcanic nature has ever made, and one of the most beautiful sights that mortal man has ever been permitted to behold. On that evening, about 7.30, the first signs of fire were visible, and all through the night at intervals it sent up quick darts of lurid light, sometimes of a burning red, and at other times a bluish or pinkish flame; the reflection on the clouds, as some large flash burst forth, presented all the features of sheet lightning, and the light always appeared in the same place, and on one occasion four or five flashes occurred at the same instant; but whether it was due to the condensed clouds of vapour being highly charged with electricity, or whether it was caused by fire being ejected from the volcano, it is difficult to determine. And

thus we were permitted to see the various forms through which it passed, from that of a submarine volcano, with its dashing boiling stream, to that of a volcanic island ejecting its heated stones, mud, cinders, &c.

This volcano forms one of the linear series of volcanoes which run in a direct line from the Culibras to Fonualei, bearing N. by E. ¼ E. and S. by W. ¼ W. magnetic.

There are no less than six volcanoes in this belt, including the recent one, and all in the Friendly Islands Group, viz.: Sandfly Rock, Tofua, Kao, Wesley Rock, Late, and Fonualei. This is the order in which they stand from the recent volcano. Of these Kao is the highest, and is 5,000 feet in height, but has not been active for many years; its crater is on the N.E. side, and the shape of the island is that of a large cone. The next in height is that of Tofua, a large razor-back island, with the crater on the N.E. side. This is 2,800 feet in height, and has been slightly in action only a few months ago. The next is Late, 1,790 feet, and is still in action. Then comes Fonualei, which in some parts is about 600 feet, but has not been active for more than thirty years. The last volcano is that of Wesley Rock, which sprang up as a submarine volcano in the year 1858, and was discovered by the *John Wesley*: it is now about 400 feet, and occasionally very active. It is somewhat singular, and perhaps worthy of notice, that the mouth of all the craters of these volcanoes has an easterly aspect. But whether the present volcano has burst out on a part of the Culibras reef we are not prepared at present to say, the Culibras reef being marked on our chart more to the S.W. And a circumstance of considerable interest in connection with the Culibras reef is that it has fallen and risen several times during the last few years: at times a long reef being distinctly visible above the water, and at other times not a trace of it to be found; such is the statement of authorities who went with the express purpose of ascertaining and locating its position; and on one occasion, after the lapse of a year or so, the reef was found to have shifted a distance of no less than three miles. The position of the present volcano is N.N.W. from Nukualofa, 48 miles; from Huga Tonga, N.N.W. ¼ W., 14 miles; from Huga Haapai, N. by W. ¾ W., 15 miles; and its latitude and longitude, from bearings taken on board the *Sandfly* while abreast of the volcano, are: Latitude, 20° 21′ S.; longitude, 175° 23′ W.

Since writing the above account, Captain Lane, of the *Maile*, who visited the volcano thirty-two hours after we left it, states that in his opinion the volcanic action is dying out, that the upheavals are becoming in a marked manner less in height, that the largest he saw was only about 5,000 feet high, and that the island did not appear much more than a mile in length; but others of his ship's crew give two and a-half to three and a-half

miles as its length. The captain also states that the island is now fully 150 feet high. But yesterday and to-day (October 19th) the volcano, as seen from Nukualofa, is again as active if not more so than ever.

The difficulty of putting on paper anything like a correct idea of this grand sight will be fully admitted by every lover of science, but we trust that this short description will enable some who were not permitted to be with us to form some idea of this magnificent spectacle of our latest volcanic eruption.

Art. VI.—*The Maori Language, with Remarks on the Reform of English Spelling.*

By James Coutts Crawford, F.G.S.

[*Read before the Wellington Philosophical Society, 21st October, 1885.*]

Prefatory.

I use, for illustration, the vowels as generally pronounced in Italian, German, Spanish, excluding the French modifications. In a reform of the English alphabet it is difficult to say how to express the sound of the English *e*, the Continental *i*. This latter vowel is so much used in English, in such words as *tin*, *sin*, &c., that it would be difficult to establish as *e*, and therefore, perhaps, the German *ie* will be preferable for the purpose.

I use the German diphthongs *au*, *ai*, *ei*, *iu*. Italian, I think, has no diphthongs, the vowels in that language are all pronounced separately. I have used *ae* to represent the English *a*, as in *fate*. This is perhaps non-phonetic, but it is in accordance with Teutonic usage; *a* has always the broad sound, as in *man*.

I have used *ao* to represent the English *aw*, as in *law*, but I am inclined to think that it would be better to adopt for this purpose what appears to be the Dutch plan, viz., *aa*.

It is sometimes inconvenient to use the German *ie* to represent the English *e*, as for instance, in Scripture names. In those cases I have retained *i* alone.

It is a matter for congratulation that, whoever reduced the Maori tongue into a written language, has avoided the absurd attempt to adopt it to English vowel sounds, and has adopted the Continental vowel system and pronunciation. The Maori language has, in consequence, assumed a form and appearance of structure and of culture which would have been lost had the English system prevailed, and the result is, that the moment a

word in the language is seen, its pronunciation is at once apparent.

If we compare this system with that which was formerly in vogue when English orthography was applied to the names of persons and places in India, native names in Australia, and also in America, we may perceive at a glance the advantages gained by the practice adopted with reference to the Maori language.

In reading most books upon India, it is almost impossible for a person uninitiated in the native tongues to tell the sounds of the native names and designations. Thus we find the two chief tribes of Afghanistan described as the Barukzye and the Suddozye. When spelt Barukzai and Suddozai the pronunciation is obvious, but as they stand in the previous orthography there is an uncertainty about the sound, inasmuch as the letter *y* is pronounced in English in several different ways. The name of the kingdom of Oude is almost invariably pronounced wrongly by outsiders, as the spelling and the pronunciation are so inconsistent. One of the most irritating words, to my mind, in this orthography is *sepoy*, which is a barbarous corruption of *sipahi*, a foot soldier. In the English form the word has a ludicrous appearance.*

The other day, in an Indian work of merit, I came across the words *gui hye*; now who can tell, except he is told by an expert, what to make of this? Pronounce the words to a Maori, and he would at once write down *kuai hai*, about the sound of which there would be no mistake. *Brandee pawnee low*, a sentence which formerly was much heard in India, looks barbarous enough; a Maori would put it down as *Parani paoni lau*, which looks civilized.

The orthography of native names in Australia has similar defects to those above described in India, chiefly caused by making the letter *i* stand for the diphthong *ai*. Thus we find *Koraio* spelt *Corio; Bulai, Bulli; Molongulai, Molongulli; Merai, Merri.* This blunder is not constant, however, for we find Gundagai spelt correctly.

In Fiji, and at the Cape of Good Hope, we find fanciful spelling. In the former we find *c* represents *th*, and *o* stands for *om*. Thus *Thakombau* is spelt *Cacobau*. In South Africa we find *Ketchwayo* spelt *Cetewayo; Etchowe, Ekowe.* This style is provoking, as apparently meant to puzzle people, without sense or reason. The result is that these names are generally pronounced wrongly.

One peculiarity the English have is in vulgarizing names. The King *Kaofi Kalkali*, of Ashanti, is reduced to *Coffee Calcalee*, although his name has doubtless nothing to do with coffee; the

*A corrected official orthography for India has been issued, but many do not use it.

corn fodder of South Africa is spelt *mealies*, although not ground into meal, and *milis* would be the correct term. Various plants pass under the name of *tea* tree, including the *ti* (*Cordyline australis*) of New Zealand. The name of the old town of Aymouth is changed to Eyemouth, and Tung we find as Tongue. The euphonious name of the Pass of Branda is changed into *Brander*, giving one a suspicion of cooking. The names of the Irish towns, Tallogh and Mallogh, are changed into Tallow and Mallow from the dropping of the gutteral; but why not *Tallo* and *Mallo*. The *w* is of no use, but vulgarises the names by suggesting common articles. In Stanley's work, "How I found Livingstone," I find the word *Seedy* for *Sidi*, the name of a very useful tribe of negroes, many of the race being employed as firemen in the P. and O. steamers. There is no reason to suppose that they are of drunken habits, but the English spelling conveys that idea.

It was curious at the time of the war in Afghanistan to see the puzzle of the London newspapers, as to the spelling the name of the ruler of that State. His right name being Shir Ali, had been Frenchified into Shere Ali; and when a fort had to be named after him, instead of reverting to the correct name of Shir, they made the name Sherpur, "the town or fort of Shir Ali." A man must be very vowel deaf indeed who cannot see that this must alter the whole sound of the word.

Various attempts are now being made to reform the orthography of the English language by the Americans, and by the Spelling Reform Association and others in England.

In neither case are the results scientific or satisfactory.

The Americans seem to think that the main point to be attained lies in shortening the words, by omitting unnecessary consonants; the English by stereotyping existing sounds.

The English and American ears have become in a manner deaf to the true value of the vowel sounds, and require preliminary instruction before undertaking the reform.

Thus, by the American plan, by leaving out one *l* in such words as *spelling*, *shilling*, *willing*, &c., we should soon, with the defective ear, get to the following changes in pronunciation, viz:—*speling*, *spieling*; *shilling*, *shailing*; *willing*, *wailing*. Another American change is spelling *plough* as *plow*, which is non-phonetic and objectionable; *ow* is a barbarous way of rendering what can be better done by *au*; besides which it is discredited for the purpose, as we have *bow* = *bau* and *bo*; *row* = *rau* and *ro*; *stow* = *sto*, &c.

So much for American innovations. The English idea seems to be to stereotype all the defective sounds at present existing, and apparently in the interests of the South of England and the Cockney dialect, ignoring the North. Thus we should soon lose the broad *a* and the sound of the letter *r*. A notable instance of

the latter is the proposal to render *father* and *farther* equally by *fadha*.

The most provoking thing in the interests of spelling reform is that men of the highest education in England are as unconscious of the defects in scientific orthography as the most ignorant of the people. Until they awake to a sense of the incongruity there is little hope of a reform in the right direction. Thus we hear *Ismailia*, *Port Said*, &c., pronounced in the French fashion, which is altogether wrong, either with reference to the diphthong or to the Arabic name. We have *Aeden* for *Aden*, *Gaol* for *Point-de-Galle*, *Aethos* for *Athos*. We may hear *Mehemet Ali* called *Mihimet Aelai;* although, strange to say, *Pacha* is not yet converted into *Paechae*. We find *Lima* called *Laima*; *Rio*, *Raio*; and even *Panama*, *Paenaema*. Lately I heard a learned archdeacon, who had travelled in the East, talk of *Baeaelbec*, unconscious that the double *a* should give an extra breadth to the sound.

At the time of the Crimean war, we used to hear of *Bisaika Bay* for *Besika Bay*, *Skiuterai* for *Scutari*, &c. On one occasion on returning from Lake Taupo, a well-known New Zealand statesman, an M.A. of Oxon, in a conversation we had together respecting the interior of the island, insisted on giving the French sound to the word Taupo, as if *au* represented the same sound as *awe* in English. I objected. He said, "I pronounce it as spelt, and I object to the foreign spelling of the Maori language." I replied, "How then would you spell Taupo in English fashion?" He said "*Towpo*." My reply was, "That would in English make the word sound *Topo*, although a Scotchman might probably hit upon the correct pronunciation."

A Saturday Reviewer lately objected to the spelling of *Hawaii*, preferring Captain Cook's orthography of *Owhyhee*. There is no accounting for taste; but the Hawaian language has been brought into a phonetic orthography, and Hawaii is the name of the island, and of the kingdom, which Owhyhee as usually pronounced is not; but if we accent Ōwhȳhēe thus, we arrive very nearly at the sound of Hawaii.

The reasons why English orthography is so irregular are sufficiently obvious:—

1. The peculiar sounds given to the vowels in the English alphabet.

2. The adoption of a peculiar mode of pronouncing Latin, and also of Scripture names.

3. The introduction of a number of French words into the language, which are sometimes pronounced in French, in others in English, fashion.

4. The small attention which is paid in England to the study of other foreign languages than French.

The first-named reason has probably been the cause of all the rest. The child is taught that *a* = *ae;* no broad *a* is taught.

e = *i*, or German *ie*.

i is a diphthong = *ai*.

o, as in other European languages; but in practice has several sounds.

u, also a diphthong = *iu*.

y = *uai*.

Thus we find three diphthongs represented by *i*, *u*, and *y*; three diphthongs in six letters. No other European language, that I know of, represents diphthongs by vowels. It is unfortunate that the broad *a* is not represented in the English alphabet, the child being taught that *a* = *ae;* the consequence is that in these days of education *ae* is rapidly taking the place of *a*. I lately heard a newsboy in London calling "*Staendard*." I find *bass* (fish), in the West of England called *baess*. At a meeting of a scientific society, I heard *basalt* called *baesaolt*. I was almost tempted to ask whether the lecturer was talking about bay-salt. It is a curious fact that when the letter *a* appears twice in an English word it is rarely pronounced the same way in both instances. One letter is *a*, the other *ae:* as in *passage, passaege; facilitate, facilitaete*. Often the change goes in the other direction. Thus we hear *Garibaldi* called *Garibaoldi; Gibraltar, Gibraoltar; Malta, Maolta; malt, maolt; halt, haolt*.

The introduction of French sounds into a Teutonic language has made great mischief. These in question are non-phonetic, and unsuited to the character of the English language. Thus, in French we have *mais* = *mes*, *tais* = *tes;* and we have introduced the same sound into English, as in *tail*, which to adapt to Teutonic spelling we should write *tael; tailor, taelor; nail, nael; sail, sael*.

Then *au* in French is sometimes equal to *o*, and at others to *ao:* as *Pau* = *Po*, *mauvais* = *movè*, *maure* = *maor*. We find the latter sound in English in *Paul, maul, haul*, &c.; whereas, phonetically, we ought to employ *au* to stand for such words as *ow* in *how*, and so accommodate to Teutonic spelling.

On the other hand, we have such French words as *invite, divide*, to which we have given English sounds. How to deal with them is one of the most puzzling things in spelling reform. If the spelling is altered phonetically, it takes the word away from its derivation; and the question is, whether a change back to the French sound can be brought about.

Then we have from the French the words ending in *tion*, such as *attention, promotion*. The French sound of *tion* is peculiar, something between *sion* and *siong*. The English shorten this into *shun*, which hideous termination the spelling reformers propose to adopt. I am inclined to say with Lord Melbourne,

"Can't you let it alone;" but if a change is to be made, I would suggest *sion*. The admixture of French words has been most damaging to the reform of English orthography.

The English mode of pronouncing Scriptural names no doubt has come about from the mode of pronouncing Latin. It is melancholy to see the loss of euphony which is brought about by this plan. I call to mind the archdeacon, with *ore rotundo* giving out the text from *Aisaiah*, without the smallest conception that *i* and *ai* should have a different sound. When I hear Hebrew words pronounced from the pulpit in English style the effect on my mind is neither sacred nor solemn, but, on the contrary, ludicrous. When I hear Sinai called *Sainaeai*, the effect passes the ludicrous, and the speaker seems silly. It is surely too bad to burlesque sacred things from the pulpit. There would really be no difficulty in bringing about a correct pronunciation of Scripture names. Forty years ago every one in church responded *Aemen*. The High Church decided upon *Amen*, and it has carried the day.

The spelling reformers would retain the present absurd pronunciation of Scripture names and alter the spelling. Thus Isaac is to be changed to *Eisak;* it should more properly be *Aisak*. Abraham is to become *Aebraham*.

If anyone cannot see the loss of force and of cadence which the English pronunciation of Scripture names involves, he must be very deficient in perception.

It is astonishing what small attention is given in England to the study of the Teutonic languages in comparison with that devoted to French. No doubt more attention has of late been given to the study of German, but few know anything of Dutch or Danish, languages closely related to English. I do not remember ever meeting an Englishman who spoke Dutch, except my own father, and he learnt it almost accidentally when commanding a frigate for several years off Java and in the Eastern Archipelago. I would strongly recommend every spelling reformer to read up Dutch and Danish, as well as German, and then he would see the correct lines to go upon.

I think it was Huxley who told the parsons to read up biology before he would take the trouble to argue with them. An English spelling reformer must remain thoroughly incompetent until he has obtained some knowledge of the other Teutonic languages.

Great uncertainty of pronunciation is caused by the use of the letter *y*, it having in English two different sounds. In the Scandinavian languages it seems to represent the sound of the English *e*, the *y grec*, and therefore we get an idea of how Danish names in England such as Whitby, Appleby, &c., should be pronounced. As pronounced in English there is a loss of euphony. Thus if we take the name of an island in the Eastern

Archipelago commonly spelt by the English *Bally*, and substitute for this *Bali*, we gain much in euphony. We might apply this to *Balimahon* for *Ballymahon*, *Balishannon* for *Ballyshannon*, &c. The use of *y* as representing the diphthong *ai* or *uai* ought to be abolished.

The change to a correct pronunciation of Latin is sometimes opposed, because people cannot decide upon the Latin pronunciation of the consonants, cannot settle whether or not *Cicero* is to be called *Sisero* or *Kikero*, Cæsar or *Kaisar*. Probably, like the Italians, the Romans pronounced *c* soft before *e* and *i*, and hard before the other vowels. Thus *Kaisar* would be correct, and *Kikero* wrong. Now this is matter of comparatively little consequence, and might be left alone; but no doubt the English do make a mess of the consonants as well as of the vowels. Thus, in German we hear them call *Schwalbach*, *Swalback*, *Schlangenbad*, *Slangenbad*; and when the tourists go to the Highlands in autumn what a burlesque they make of the Celtic names!

The effect of the degradation of the letter *a* to the inferior sound of *ae* is to eliminate the basso sounds from the language, and the result is similar to that which would be produced in an opera if all the basso sounds were omitted.

The tendency also to reduce the sound of *r* to a minimum, particularly in the South of England, diminishes the force of the language. Thus, what must a Roman think when an Englishman calls him a *womaeno*, with a faint approach to a roll in the middle of the *w*? Or imagine an Englishman in the days of Lord Palmerston proclaiming himself, in the English fashion, "*Saivis womaenus sum!*" The force of the expression has evaporated in the feeble and effeminate pronunciation.

For the sake of force, also, it may be regretted that the English have dropped all the strong gutturals, as in such words as *light*, *might*, which still retain their old sounds in broad Scotch. With regard to the word *height*, the Americans give us an excellent illustration of a step in the wrong direction by changing the spelling to *hight*, thereby converting a diphthong into a vowel. Instead of this they ought to change *might*, *right*, &c., into *meight*, *reight*. The *gh* in these words are now of no use, but they do no harm, and serve to show where the gutturals once existed.

I must confess to a liking for strong gutturals. What force there is in such words as *Junta*, *Xeres*, *Ojos*, in Spanish, where the *j* and the *x* have the sound of the Scotch or German *ch*; or, in Arabic, of *Hassan*, *Achmet*, *Bahr*, *Mahmoud*, wherein the *h* is pronounced as a very deep guttural. How much force Spanish gains over its sister language, Italian, from which gutterals have been entirely eliminated.

Many tourists may remember John Campbell, who drove the coach from Loch Goil Head to St. Catherine's, in Loch

Fyne, and who kept his passengers in roars of laughter during the journey, chiefly from imitations of Cockney tourists. One of his stories was of a Cockney, in affected tones, asking: "Coachman, which is the way to *Straechur*?" the *ch* pronounced soft; "*Strachūrr*, Sir, I suppose you mean."

When an Englishman is remonstrated with on his pronunciation of the name of a foreign place, he is apt to say, "Would you pronounce such names as Paris and Calais as the French do?" This shows a want of appreciation of the point. Pronouncing the *s* in Paris and Calais is quite legitimate, as bringing the names into reasonable accord with English; but if we should say *Paeris* or *Paerais*, or *Caelais*, in accordance with what is often done, the damage is evident. A single vowel ought never to be employed to express a diphthongal sound. We must not have *i* to represent *ai*, nor *u*, *iu*. In English *ew* is used to represent *iu* in *mew*, *pew*, *stew*, *new*; consequently we find this clumsy arrangement applied to *Tewfik*, which ought to be spelt *Tiufik*.

One may hear educated Englishmen say that every nation has its own way of pronouncing Latin. This, as an excuse for English pronunciation of that language, is nonsense. Each foreign nation makes some slight variation, but each has fixity within its own lines. Thus we know how an Italian pronounces *u*, and how a Frenchman modifies the sound; but it is not varied within the nation. In English Latin no one can tell how *u*, or any other vowel, is to be pronounced. The English are generally supposed to be sensitive to a sense of the ridiculous; but how an educated Englishman can venture to quote Latin in the presence of a foreigner baffles comprehension. The effect must be inexpressibly ludicrous, on the supposition that the foreigner can comprehend the utterance. Possibly he takes it for some unintelligible gibberish. The difficulty of teaching a correct pronunciation of Latin lies with the masters. I remember the attempt being made at a New Zealand College, but the false system had become so engrained in the masters that they seemed incapable of throwing it off. One of them, a graduate of Cambridge, told me that they had improved *ego* into *eggo*! Out of the frying-pan into the fire. If the masters once learnt their business there would be no difficulty with the pupils.

The Latin of any Continental nation is understood by the scholars of any other: that of the English is intelligible to none.

One point in the reform of English spelling is very important, and would tend to obviate many changes. This is, instead of altering the spelling, to revert to a correct pronunciation. Apart from such matters as the pronunciation of Scripture names, I would instance such words as *natal*, *fatal*. Instead of altering the spelling to *naetal*, *faetal*, would it not be much better to pronounce them correctly, with the broad *a*. It is

only a question of teaching the teachers. The mind of the child is a blank board, ready to take in whichever sound is given; and if the teachers knew their business, there would be no difficulty with the children.

It is much to be desired that the Americans should go hand-in-hand with the English in a reform of the spelling of the language. It will be a misfortune if the two nations diverge in their orthography. The English are more in contact with foreign nations, and therefore, in this respect, more favourably placed for effecting a reform. On the other hand the Americans have a large German population; and if they would humble themselves to admit the defect in ear, which they have in common with the English, and call in some Germans to their help, they might lead the way, and the English would be obliged to follow. They have also got Mark Twain, and if he took the matter up he would carry it to successful issue. His observations on the defects of German grammar show that he would be equally alive to those of English orthography. In the meantime the American attempts at reform are possibly mischievous, and certainly useless, and as much may be said of many of the English propositions. I would advise the Americans to spell *Ohio* and *Iowa*, as *Ohaio* and *Aiowa*. This would point to the direction in which reform should go.

The objects that should be aimed at are:—

1. The language should be thrown into gear with those of Northern, Central, and Southern Europe.

2. English, being a Teutonic language, should, as far as possible, be brought into accord with German and Dutch, as also Scandinavian.

3. As a preliminary step in the reform, the classical languages, particularly Latin, should be pronounced as in German and Italian, &c.

4. Scriptural names should be pronounced as on the Continent, and the spelling left unchanged.

And now a few remarks with regard to the deterioration of the Maori language may not be amiss. This language has been reduced to a correct orthography; but emigrants arrive from England who know nothing of it, and who have been taught Latin in the English style. They at once begin to spoil the names of places. Thus *Ti nui*, the big *ti* or cabbage tree, becomes *Tenui*, literally *the big*, which is senseless. *Pitone*, or *Pito-one*, the end of the beach, becomes *Petone*, without meaning. *Titahi*, bay, becomes *Tetai*, *Taitai*, sometimes *Teti*. *Ohiro* becomes *Ohairo*, and so on.

Apart from mispronunciation or mis-spelling of Maori, the English dialect that is developing in Australasia is not satisfactory. The tendency is to a modification of Cockney. Thus we generally hear "*I seen him*" for "*I saw him*," which is certainly

queer grammar; but sometimes this is diversified by "*I sawr 'im.*" As expletives, "*My word*" and "*No fear*" are favourites, both drawn out as long as possible. The letter *h* is frequently treated in Cockney fashion, *i.e.*, omitted where it should be pronounced, and put in where not wanted.

I have often observed in London Colonial newspapers complaints of the use of Maori names, as being unpronounceable, &c. Considering that the Maori language is softer than Italian, this shows how much the writers know of what they are writing about. I should strongly object to displace the soft, easily pronounced, and generally descriptive Maori names, by the Bellevues, Mounts Brown, or Smith, or Jones, or other names showing the poverty of the English language for nomenclature. Compare the Spanish language for this purpose. Masafuero, the name of a small island outside Juan Fernandez, means literally *more far*, or *farther off*. Expressed in English the name would never do, whereas in Spanish it is sonorous and euphonious. Similarly *Cape Cow's Tongue* will not answer, whereas *Cabo Lengua de Vaca* is euphonious and appropriate. Even in Great Britain the old Celtic names are generally the best, and have more poetic meanings than the more homely names of the Sassenach, such as Pitmuis, "the field of blood," Kilkiaran or Kilkerran, "the cell of Kiaran," &c.

The sound of the letter *s* has been very often changed in English to that of *z*, as in *is, iz; was, waz*. The spelling reformers would change all these into *z*. Cannot the original sound be reverted to? In phonetic printing the frequent occurrence of *z* looks hideous, almost as bad as *shun*.

Some persons may say, Why should we object to the French sounds in the language and prefer the Teutonic? The reply is easy: English is a Teutonic language, and although it has borrowed many words from French, it can under no circumstances be converted into a Romance language; besides the French sounds are non-phonetic—as such they do not do the same mischief in French as in English, because in the former language the sound is nearly constant, whereas in the latter it is arbitrary and variable.

Certainly the pronunciation of French words is peculiar. We find *eau, eaux, au, aux*, all = *o*; *beau* = *bo*, *peau*, *pôt* = *po*, *maux* = *mo*, *faux* = *fo*, *chateau*, *chato*. We adopt some of these words into English and call *beau*, *bo*; but *beauté* we call *biuty*. *Beauly* (firth), we call *Biuly*. Then the French call *comment*, *commong*; *vraiment*, *vraimong*; *appartient*, *appartieng*; *proportion*, *proporshiong*; *maison*, *maesong*; *bon*, *bong*; *mauvais*, *movae*; *suis*, *sui*; *es* and *est*, *ae*; *sommes*, *som*; *êtes*, *aet*; *sont*, *song*. This is not the language on which English orthography should be reformed. It is essentially a Latin *patois*, the rule being to cut off the final syllable of Latin, thus: *Rome* for *Roma*; *bon* for *bonus*,

French is the foreign language which is most taught in England. The consequence is that Englishmen suppose there is no such thing as a phonetic language. If German, Italian, and Spanish were more taught they would learn to understand the subject.

A few more peculiarities of English present themselves. *Cacao* we spell *cocoa*, and pronounce *coco*. *Bilbao* used to be, and often is still, spelt *Bilboa*. *Kakatua* we spell and pronounce *cockatoo*. The name has nothing to do with a cock; the bird may be a hen. *Kaka* is the generic name for parrot among many languages of the East, and *kakatua* is that of the particular family.

Chinchona we spell *cinchona*, and generally pronounce as if it were an Italian word. The name, if Spanish, was derived from that of the Countess Chinchon, wife of the Captain-General of Peru, and *ch* in Spanish is always soft, as it is generally in English. There is, no doubt, the authority of Linnæus for *cinchona*, but he evidently made a mistake in this name.

In the first attempt of a child to speak he says *ba*, and this whether he is of English or any other race. When the child grows up and goes to school we tell him that *a* = *ae*, and therefore that *ba* ought to be *bae*. Luckily he knows better, he has found out by instinct that *ba* is *ba*, and not *bae*. Afterwards he learns to say *papa* and *mamma*, and notwithstanding the teachings of his alphabet, he does not call them *paepae* and *maemae*. Advancing in age he speaks of his *father*, not *faether;* although, strange to say, the Scotch adopt the latter sound, contrary to their usual habit of broadening the vowel *a*.

In these days of æstheticism it is utterly impossible that the orthography of the English language can remain long in its present barbarous and almost ludicrous state, but the change to a more correct system must be brought about by real linguists and men of taste, men who thoroughly understand the Teutonic languages—not only German, but Dutch, Flemish, and the allied Scandinavian tongues. Until some result is arrived at by men of the above-named qualifications, it would be much better for both English and Americans to desist from any premature changes.

It appears to me to be a misfortune that the Teutonic name *berg*, mountain, should have been lost to the English language, except in *iceberg*, and the Romance names *mount*, *mountain*, substituted. *Mount* may generally be considered as a diminutive of *mountain*, but we find it applied to mountains of the greatest elevation. Thus we find in Mount Cook, Mount Everest, and other mountains of the first class, the name *mount* filling the position which it does in the Mounts Pleasant, or Brown, or other small elevations in the vicinity of English towns. Cookberg and Everestberg would be infinitely better. In New

Zealand we have the relative height of elevations well defined in *maunga*, mountain; *puke*, hill. Suppose we convert Mount Cook into Maungakuku, this would be much more euphonious than Mount Cook, and serve as well the purpose of commemorating the name of the great discoverer.

Mount, as a rule, is applied to a hillock; when exceptionally used to denote the highest mountains in the world the effect is feeble.

To return to a few more illustrations. The German name for *ice* is the same as our own, but they spell the word *eis*. Any one can see that the German spelling is phonetic, but what shall we say to the English *ice*. The *i* is made into the diphthong *ei*, the *c* into *s*, and the *e* is mute and useless. In the same category we have *nice*, *twice*, *rice*, *spice*, *mice*, &c. The mute *e*, at the end of words, ought to be abolished.

What must a foreigner think when he hears an educated Englishman talk of *Demostheniez* and *Pericliez*. This pronunciation has a thoroughly illiterate effect, something similar to the crier in Court calling out, "*Oyiez*, *Oyiez*," or of a lawyer talking about *laechiez*, or of *Naisai Praius*. The pronunciation is not even according to English custom, for we do not say *Agniez*, *businiez*, *Totniez*, *pricklie*z, *wrinkliez*. When an Englishman is asked why he does not pronounce names correctly, he says that it would look like affectation to do so, whereas the affectation is all the other way.

A few illustrations will show in what a curious way the letter *o* is treated in English. We find its different and varying sounds in *tome*, *tom*, *one*, *come*, *cooper*, *coffee*. There may possibly be more variations. I have picked out the above at random.

Now all these various defects in English orthography have a strong bearing upon the future of the Maori language. That language has been brought into a phonetic orthography, and many of the European settlers understand this: but every day fresh arrivals come from England who know nothing of the subject, and who proceed to damage the Maori tongue. The culprits are to be found in the Post Office Department; as compositors in newspaper offices; as officials in the Land Office, and in the public generally. Thus we find the native names mis-spelt and made ridiculous. I have already mentioned the cases of *Petone*, for *Pito-one*, *Tenui* for *Tinui*. I may add *Kaiwarra* for *Kaiwharawhara*, *Mangahao* for *Mangāhoa*. When I traversed the Forty-mile Bush, some twenty-four years ago, I put this name down as *Mangāwha*, which is practically the same as *Mangāhoa*. *Mangahao* does not give the sound at all.

Pauatahanui is converted into *Pahautanui*. *Ohiro* is not mis-spelt, but is pronounced *Ohairo*, and so on. One could find many similar examples. But what can be expected when

the English alphabet is treated in the way in practice: when the child is taught that *a* = *ae*, and no symbol is given for the broad *a*; that *i* = *ai*; that *u* = *iu*, &c. Let the reform begin at the fountain head, by a re-arraugement of the alphabet.

One or two Scotch names give good examples of the difficulties in spelling brought about by the want of system in English orthography. Let us take the name MacNeil. We find this variously spelt McNeil and McNeal. Although apparently a Celtic name, I suspect that it came from Scandinavia, where we have to this day the frequent Christian name of *Nil*, *Nils*. The French could make nothing of Neil, so changed the spelling to Niel, in the case of the celebrated marshal. The McNeils and Neals should do the same, and the name would then be written phonetically.

We find the name Mackay spelt the same, whether the owner of it comes from the Highlands or from Galloway; but the pronunciation is different. In the former case it is *Mackai*, in the latter *Măckae*; and at San Francisco I found another variation, viz., *Mackāe*, the accent being on the last syllable.

In looking up the Scandinavian languages, I have been struck with the similarity in some respects to broad Scotch, and I suspect that the language of the old kingdom of Northumbria, extending from the Humber to the Forth, has been more influenced by Scandinavian immigrants than is generally supposed. Such words as *baru* for *bairu* are suggestive; and in Norwegian I found a sentence, viz.: "*Qua sae?*" meaning "What do you say?" which one may hear any day in the streets of Edinburgh or Glasgow.

Art. VII.—*The Non-Euclidian Geometry Vindicated: a Reply to Mr. Skey.*

By F. W. Frankland F.I.A.

[*Read before the Wellington Philosophical Society, 13th February*, 1884.]

The following observations are an abridgment of a series of letters addressed to Mr. Skey, the author of the paper entitled "Notes upon Mr. Frankland's Paper 'On the Simplest Continuous Manifoldness of two Dimensions and of Finite Extent,'" read before the Wellington Philosophical Society on 26th June, 1880, and contained on pages 100–109 of the thirteenth volume of the Transactions of the New Zealand Institute. By Mr. Skey's kindness and courtesy these letters were made available to me for the preparation of a printed reply to his criticisms. I make no apology for the form in which this reply appears. I have taken, *seriatim*, the main points which Mr. Skey raised, and replied to each of his contentions in detail. Mr. Skey's own words are in each case placed at the commencement of the

paragraph, and the number of the page from which the quotation is made is indicated. It seemed to me that in this way only could a searching and exhaustive refutation of his arguments be given.

1. What is meant by the assertion that "the axioms of geometry may be only approximately true"? (p. 100) It means that the actual physical constitution of the space in which we live may be different from the space treated of in works on solid geometry, but that it must be *so nearly* the same that we cannot detect the difference by the most delicate experimental methods at our command.

2. "The author then adverts to 'the existence' of a particular manifoldness, which has been treated by Professor Clifford in a lecture on the postulates of space" (p. 101). I mean it *exists* in the sense of being logically constructible, not in the sense that any surface in the space in which we live possesses such properties. It *may* be that planes (or *flattest surfaces*, if the expression be preferred,) in the space in which we live possess the properties of this "manifoldness." We cannot know whether they do or not. If they do, at any rate their total areas must be immensely large.

Perhaps it may be said that any absurd scheme of pseudo-geometry is "logically constructible." But this is not the case. It is not possible, for instance, to construct a scheme of geometry in which two shortest lines enclose a space (all shortest lines being supposed congruent), and in which the three angles of a triangle are always less than two right angles. Such a scheme would be logically self-contradictory. For it is logically involved in the assertion that two shortest lines may meet twice, assuming all Euclid's other axioms to be true, that the three angles of a triangle are always *greater* than two right angles. They *cannot*, under such circumstances be either equal to 180° or less than 180°.

3. "Then he describes how this space is analytically conceived, with the object of putting us in a position to apprehend certain discoveries of his own, which relate to its very singular properties" (p. 101). The manifold* I described in my paper is not a *space*. It is a manifold of *two* dimensions, not of *three*. It may be described as an unimaginable but logically constructible *surface*.

4. It is not accurate to say that Professor Clifford "imputes finiteness" to the universe or to space. He says, in common with most living mathematicians who have studied this question, that space *may* be finite—not that it *is* finite. Its possible finiteness is spoken of, not in the sense of its having a *boundary*, which would be unmeaning, but as implying that space may return into itself, so to speak, just as the surface of a sphere and

* This term is now generally used instead of the more cumbrous "manifoldness."

the circumference of a circle return into themselves. In other words, the totality of space may have a finite volume, just as the surface of a sphere has a finite area, and the circumference of a circle a finite length. As far as pure mathematics go, we cannot decide whether space is infinite or finite. *Experience* alone can decide; or, rather, although we cannot imagine any experience sufficiently extensive to prove the infinitude of space, experience may possibly some day prove its finiteness.

5. "The prime object" of the paper "is to spread and support the views of the metaphysical school." . . . . "This view is supported by the fact, that just recently this gentleman has read before us a very able and profound paper, entitled, 'Mind Stuff,' and which is evidently of a highly metaphysical character" (p. 101). The allegation here quoted is so far from being correct, that I claim for my paper on "Mind Stuff" the character of complete consistency with the experiential philosophy. It endeavours to show that the only things of which we have any direct knowledge are the feelings we ourselves experience. By a legitimate inference from experience we conclude that there is a world outside us which causes these feelings, and this world I infer to be composed of stuff ("mind stuff," Professor Clifford called it,) remotely similar to our own feelings, but not worked up into so complex a structure. If by the "metaphysical school" be meant the school which holds that we can discover truth otherwise than by experiment and observation, then it is precisely the school which the non-Euclidian geometry has done more than anything else to confute. The geometry of Euclid has hitherto been their stronghold: "Here, at least," they have hitherto said, "the human mind can, without any appeal to experiment, evolve, from its own structure, truths which hold good with absolute exactness, throughout immensity and eternity." Now, since the researches of Lobatchewsky and Gauss this can no longer be said. They and their successors have conclusively shown that, as far as logical consistency is concerned, there are an infinite number of alternative geometries, and that experience alone can decide which of these is physically true.

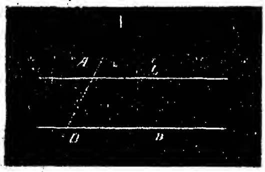
6. To the expression "geometers of the Euclidian school" (p. 101) I take exception, believing that none such are left in the sense in which Mr. Skey uses the word. The triumph of the non-Euclidian geometry, or, I will say, the "general" geometry, has been complete. I can safely appeal, on this point, to any distinguished member of any Mathematical Society in Europe or America.

7. "It is not this equivalent which Lobatchewsky is supposed to use in his attempt at demonstrating the truth of his assumption" (p. 102). Neither Lobatchewsky nor any one else has attempted to demonstrate the *truth* of the assumption, but

only to demonstrate *that no one else can demonstrate its falsity*. In other words, he has attempted to demonstrate (and that he has completely succeeded all modern mathematicians allow) that the truth of Euclid's 12th axiom can by no possible succession of syllogisms be deduced from the other axioms and the definitions of the straight line, plane, parallels, &c. Innumerable attempts had been made to do this—*i.e.*, to put the 12th axiom on the same logical footing as, for instance, the 5th proposition of the First Book. All the attempts had failed. Lobatchewsky proved, once for all, that they must necessarily fail, by constructing an unimaginable but perfectly self-consistent scheme of geometry, in which all the other axioms were assumed to be true, and all the definitions remain the same, but in which this one axiom (the 12th) was assumed to be false. The equivalents of Euclid's axiom which I have mentioned are really exact logical equivalents. If one is true, all are true. If one is false, all are false. In Euclid's space all are true: in Lobatchewsky's, all are false.

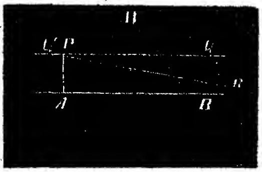
8. I propose now to establish the exact logical equivalence of the three forms of the parallel-axiom mentioned in my paper.

Form (a), (Euclid's) is:—"If a straight line meets two straight lines, so as to make the two interior angles on the same side of it taken together less than two right angles, these straight lines being continually produced shall at length meet upon that side on which are the angles which are less than two right angles." In other words, if the angle CAB + the angle $ABD < 180°$, then AC and BD will at length meet.



This is Euclid's axiom, and it is to my mind just as good as any of its modern substitutes.

I now propose to deduce from this axiom the usual modern substitute:—"It is impossible to draw more than one straight line parallel to a given straight line (*i.e.*, lying in the same plane with it, but not intersecting it) through a given point outside it." Let $QPA + PAB = 180°$. Then, by a proposition of Euclid which does *not*, directly or indirectly, rest on the 12th axiom, PQ can never intersect AB.



Draw any straight line PR within QPA. Then,

Since $QPA + PAB$ = two right angles

$\therefore$ $RPA + PAB <$ two right angles.

$\therefore$ PR will eventually meet AB (Euclid's 12th axiom), *i.e.*, PR cannot be parallel to AB. Hence no line within QPA and passing through P can be parallel to AB.

Similiarly, no line through P and passing outside $Q\ P\ A$ can be parallel to $A\ B$, for the continuation of it would fall within the angle $Q'\ P\ A$. Hence only one straight line can be drawn through P parallel to $A\ B$, viz: $P\ Q$. $Q.E.D.$

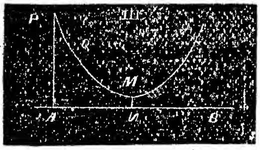
I have thus shown that if Euclid's axiom is true, then the modern substitute is true. To establish the exact logical equivalence of the two axioms, I should have to prove the converse formally, viz.: that if the modern substitute is true, then Euclid's axiom is true. But I assume it will be conceded that the above reasoning can quite well be put in the converse form. I now pass to the third equivalent, which is alleged by Mr. Skey not to be a real equivalent of the other two. If it be borne in mind that the word *parallel* in the second equivalent means *not* equidistance along the whole length of two lines; but *lying in the same plane, plus non-intersection however far produced* (see Euclid's definition)—if it be borne in mind that I define parallelism in this way, I think it will be recognised at once that the second and third forms of the axiom are merely two different ways of saying the same thing.

However, as truth and falsehood in nature can never be dependent on the signification of *words*, I may as well say how the axiom would be worded if we define two straight lines to be parallel when they are equidistant along their whole length. (I vastly prefer this definition, though it is not the usual one.) Taking this as the definition of parallelism, Euclid's axiom may be stated thus:—"Two straight lines lying in the same plane, and not being parallel, (*i.e.*, not equidistant along their whole length,) must ultimately intersect if sufficiently produced in both directions."

In Lobatchewsky's geometry, on the other hand, straight lines in a plane need not intersect though they are *not* equidistant along their whole length. They may approach each other for awhile, reach a minimum mutual distance, and then recede more and more continually. Also in Lobatchewsky's geometry *no* two *straight* lines can be parallel, in the sense of being equidistant along their whole length. If two lines are parallel (*i.e.*, equidistant along their whole length), they cannot both be straight. One, at least, must be a *curved* line, *i.e.*, a longer line than some other which could be drawn through any two of its points.

9. "Nothing is said as to the distance away from this line at which the point is to be placed" (page 103). (This quotation refers to the point outside the first line through which the second line is drawn.) The distance of the point from the line may be as short as possible, and still (if Euclid's 12th axiom is untrue) there will be a finite angle through which the rotating line can be turned without *ever* intersecting the fixed line: the magnitude of this angle depending partly on the distance of the

point and partly on the nature of the space under consideration (*i.e.*, on the degree to which the space deviates from the properties of the ideal space of Euclid). For there are spaces *and* spaces which satisfy Lobatchewsky's conditions. There is only one space which satisfies Euclid's conditions, but there is an infinite number satisfying Lobatchewsky's. They vary through infinite gradations, from one which has such feeble "negative curvature" that it can hardly be distinguished from Euclidian



space, to one which has such strong "negative curvature" that even $P\ Q$ (in the annexed figure) would not meet $A\ B$, but would rapidly come to its point of minimum distance ($M\ N$), and would then recede for ever from $A\ B$.

Now, in regard to the space we actually live in, we ought, in my opinion, to say this: "It may be Euclidian, or it may have negative curvature: but if it has negative curvature, that curvature must be excessively weak, though not *infinitely* weak, as is suggested." Professor Clifford puts the case very well in his lecture on "The Aims and Instruments of Scientific Thought." He says: "Suppose that three points are taken in space, distant from one another as far as the sun is from α Centauri, and that the shortest distances between these points are drawn so as to form a triangle, and suppose the angles of this triangle to be very accurately measured and added together: this can at present be done so accurately that the error shall certainly be less than one minute, less therefore than the five-thousandth part of a right angle. Then I do not know that this sum would differ at all from two right angles; *but also I do not know that the difference would be less than ten degrees, or the ninth part of a right angle. And I have reasons for not knowing.*"

Clifford introduces this example by saying, what requires to be much insisted on, that these speculations on non-Euclidian space are not merely questions of words, as many people imagine, but that the issue involved is "a very distinct and simple question of fact." In plain language, geometry is a *physical* and *experimental* science, just as much as optics or physiology; and the properties of space cannot be evolved from man's inner consciousness, but must be determined by *experiment* and *observation.* There was as much justification, before the curvature of the earth was known, for erecting into an axiom the proposition that all verticals are parallel—(For myself, I cannot, even now, *imagine* its falsehood, although I of course *know* it to be false)—as there is now for the statement, *a priori*, that two shortest lines cannot enclose a space, or that the three angles of a triangle are exactly equal to two right angles.

10. " . . . it appears to me that even if the angle of convergence is infinitely small the lines would intersect, but not, of

course, at any determinable or conceivable distance" (p. 103). This is beside the question. The true question is, whether they will necessarily intersect if the angle is, for instance, one decillionth of a degree. Those who regard the Euclidian geometry as absolutely true, must hold that they will. Modern mathematicians, on the other hand, say that we do not know whether they will or not. Who can prove that they will? Euclid frankly admitted that he could not, by *assuming* the alleged fact as his twelfth axiom. Since Euclid's time, scores of mathematicians have tried to prove it, but all their attempted proofs are justly regarded by their fellow-mathematicians as simply inconclusive. It *cannot* be proved. Experiment cannot prove it; reasoning has failed to prove it: our intuitions—if, as disciples of the experiential school of philosophy, we believe they have been produced by the experience of our ancestors through millions of years in the portion of space passed through by our solar system in that time—cannot be trusted as infallible, and, therefore, cannot prove it. Lastly, it will not be contended that any supernatural revelation has been vouchsafed on this point.

11. "None of the evidence of Lobatchewsky in favour of this is given by Mr. Frankland" (p. 104). It did not fall within my province to give this evidence. It is to be found in Lobatchewsky's works. The evidence is admitted, and has long been admitted, to be conclusive by all mathematicians who have studied the question. Also, I think I may fairly add that the burden of proof lies with those who say that an intersection must and will take place, not with those who say that it may or may not take place.

12. "It appears to me that at any finite angle of convergence of $C D$ to $A B$ they will intersect at some determinable part of the line $A B$, *for a finite angle can only mean an angle of such a size* that it can be measured or conceived of." Just so: it can be measured by the ratio of a finite arc (subtended by the angle) to the radius of the same circle. But this does not prove that it must be measured by a portion of the straight line $A B$. How, then, does it follow as a "necessary corollary" that "there is a point along $A B$ which the line P will pass through?" (p. 104.) It will hardly be considered a proof to say that "It seems that the completion of the ideal construction thus begun demands this intersection" (p. 103). If this can be proved, the most remarkable advance in geometry since the time of Euclid himself will have been made. A whole literature has grown up in the attempt to furnish this proof. Its growth has been arrested by the discoveries of Lobatchewsky and Gauss, and I feel very sure that the desired proof will never be forthcoming.

13. Mr. Frankland (p. 106, *note*) "gravely informs us here, that the finishing point or goal for a geodesic line in process

of construction is to be the length of such a line away from the starting point of that line. The two points are to be apart, yet coincide!" Where is the contradiction? In the manifold I describe, as on the surface of a sphere, a geodesic starting from any point leads back eventually to that point. So far, my manifold and the surface of a sphere resemble one another. The difference is this: If two persons on the surface of a sphere (say the earth) were to start from the same place, and travel along geodesic lines, they would cross each other's paths at a half-way house (on the other side of the sphere), and then again at the starting point. But on the manifold I have investigated they would, after travelling a certain distance, get back to the starting point, *but without ever having crossed each other's paths in the meanwhile.* On a Euclidian plane, on the other hand, they would obviously never either cross each other's paths or get back to the starting point at all.

14. "Geodesic lines, then, proceeding from some common point of a surface, are to diverge somehow from the polar of that point" (p. 106). I do not know what Mr. Skey means by the "polar of that point," unless, indeed, it be the *opposite* point. If so, I reply that in my manifold, which for the future we may for convenience call the "finite plane,"* a point has not *one* opposite only (like a point on a sphere), but a whole row of opposite points: that is to say, an opposite *line.* The geodesic lines proceeding from a common point cut this "opposite line" (which I have called the polar) in *separate points*, *each of which* is equally "opposite" to the common centre of radiation.

15. "He is assuming a uniformly curved surface of immense size" (p. 106). By no means. The manifold may be of any size, large or small. Its total area may be less than the decillionth part of a square inch—yet it will have its complete and thoroughly self-consistent, though, I admit, quite unimaginable, geometry. What I do say is that, if any surface *constructible in the space in which we live* possesses the properties of a "finite plane," then that surface must be of immense size, for we can prove by experiment that no closed surface of *moderate* area constructible in our space does possess these properties.

16. "It is manifest that the analytical conception of two geodesic lines refusing to intersect each other more than once, and so enclosing but one space, is founded upon Lobatchewsky's conception of what parallel straight lines are capable of" (p. 106). This is not so. It is founded on just the opposite conception. Lobatchewsky's conception is that of two geodesic lines which, even though converging at first, do not ultimately intersect; mine is that of two geodesic lines which ultimately intersect,

* The manifold in question possesses the same properties as the "plane at infinity," well known to students of solid geometry.

even though divergent at first. In Lobatchewsky's space the three angles of a triangle are always together less than two right angles: in the "finite plane" (and also in the corresponding space of three dimensions,) they are always greater than two right angles, just as the angles of a spherical triangle are. In Lobatchewsky's space, figures have their edges and corners sharpened when their linear dimensions are proportionately increased: in the "finite plane" they have their angles blunted on being magnified, (like the figures on a sphere,) and in the corresponding space of three dimensions solid figures would also have their edges and corners blunted on being magnified.

17. "It is, I think, abundantly evident that the analytical conception of a surface such as the one which has been worked upon for the discoveries communicated in his (Mr. Frankland's) paper, is not, in reality, valid, and that though possibly not self-contradictory, as he urges, it requires premises which *are* of this nature"—*i.e.* self-contradictory (p. 107). Not so. The premises are not self-contradictory, but only contradictory to some of our strongest and firmest intuitions—viz., our space-intuitions. But so is the convergence of verticals, already alluded to, and yet it is an unquestionable fact. Believing, as I do, that our space-intuitions are derived simply from ancestral experience, aided by natural selection (which must always have tended to eliminate those in whom such intuitions were relatively weak), I can only admit that they are reliable enough *for practical purposes;* not that they are exactly true through all space and time. The parallelism of verticals was an intuition, (a sort of dynamical intuition,) ingrained in our mental constitution by ancestral experience through innumerable generations. Were we blind, and confined (say by surrounding climates of excessive rigour) to a very limited area of the earth's surface, I think it very likely that this conception would to this day seem to us self-evidently true. It would seem as certain that two verticals must have the same direction as it now does that two shortest lines cannot enclose a space. A Skey, in such a world, might even have argued that to construct a system of cosmography in which two verticals should not have the same direction would be, "though possibly not self-contradictory," to assume "premises which are of that nature." In any case, I do not think that any self-contradiction can be shown to be involved in the proposition that two geodesic lines, though finite in length, intersect only once.

18. "Referring to the idea that the universe is of finite extent," . . . . the Professor "argues that 'in this case the universe is again a valid conception . . . . for the extent of space is a finite number of cubic miles'" (p. 107). In this quotation from Professor Clifford, two important words

are omitted. The original reads thus:—"In this case the universe, *as known*, is again a valid conception," &c. Professor Clifford very clearly explains what he means by this, in an earlier part of the lecture from which I quoted. Referring to the state of science before Lobatchewsky he says, " . . . . the laws of space and motion that we are presently going to examine, implied an infinite space and an infinite duration, about whose properties as space and time everything was accurately known. The very constitution of those parts of it which are at an infinite distance from us, 'geometry upon the plane at infinity,' is just as well known, if the Euclidian assumptions are true, as the geometry of any portion of this room. In this infinite and thoroughly well-known space the universe is situated during at least some portion of an infinite and thoroughly well-known time. So that here we have real knowledge of something at least that concerns the cosmos; something that is true throughout the immensities and eternities. That something Lobatchewsky and his successors have taken away. The geometer of to-day knows nothing about the nature of actually existing space at an infinite distance: he knows nothing about the properties of this present space in a past or a future eternity. He knows, indeed, that the laws assumed by Euclid are true with an accuracy that no direct experiment can approach, not only in this place where we are, but at places at a distance from us which no astronomer has conceived: but he knows this as of here, and now; beyond his range is a there, and a then, of which he knows nothing at present, but may ultimately come to know more. So, you see, there is a real parallel between the work of Copernicus and his successors on the one hand, and the work of Lobatchewsky and his successors on the other. In both of these the knowledge of immensity and eternity is replaced by knowledge of here and now. And in virtue of these two revolutions the idea of the universe, the macrocosm, the all, as a subject of human knowledge, and therefore of human interest, has fallen to pieces."

Well, then: If space should turn out to be of finite extent, the idea of the universe (the universe of *matter* at any rate) would be reinstated, as in a certain measure an object of knowledge throughout its entire extent, as it was supposed to be before Lobatchewsky arose, when Euclidian geometers could tell us the exact constitution of the whole of space.

19. "To make the conclusion agree with the premises, it should have gone no further than to affirm that the universe may not differ *sensibly* from an infinite one" (p. 108). By no means: The surface of a sheet of still water does not differ sensibly from a Euclidian plane, but the surface of the Pacific Ocean, even if perfectly calm, differs very sensibly from a plane,

The imperceptible divergence of small portions from the ideal standard is *cumulative*, and when we take very large portions the divergence accumulates to a very perceptible amount. The difference between the geometry of a cubic mile, if Euclid's assumptions are true, and the geometry of a cubic mile if they are false, we know, by experiment, to be quite insensible: yet by the accumulation of excessively small (though not infinitely small) divergences, it comes about that the geometry of a decillion cubic miles (*i.e.*, 10^{60} cubic miles) may be so different on the two hypotheses, that while, if Euclid's assumptions are true the decillion cubic miles are but an infinitesimal portion of entire space, if his assumptions are false, all space may actually not hold so large a number of cubic miles.

20. "The Professor, having perchance, after all, some doubts as to the validity of this deduction, or possibly forgetting he has *proved* it, essays to prove it again; he says, 'and this (finiteness of the universe) comes about in a very curious way'" (p. 108). I can assure my critic that Professor Clifford had no such doubts. If the universe is such that two shortest lines may enclose a space, and if, nevertheless, all the other assumptions of Euclid are true, then the extent of space is *certainly* a finite number of cubic miles. The one statement is logically involved in the other, though it may require a long and intricate process of reasoning to prove it so.

21. "The qualification put upon straight lines, '*straight according to Leibnitz*,' put, no doubt, all in good faith, as explanative of straight lines, it does still, I feel assured, confer upon them properties which straight lines have not" (p. 108). It undoubtedly confers upon them properties which Euclidian straight lines have not; but the lines in question, though not Euclidian straight lines—and if you will, not *straight* lines at all, for the quarrel need not be over a word when the issue is one of fact—may nevertheless be the straightest lines that can possibly be constructed (even ideally) in the space in which we actually live. In other words, space may be so constituted that what Euclid calls straight lines cannot possibly be constructed in it, any more than a straight line can be constructed on the surface of a sphere. Nevertheless the straightest lines constructible may be of the same shape all along *and on all sides*, which great circles of a sphere are not: for though of the same shape all along, they are concave on the one side and convex on the other, also they may be shortest lines, which the great circles of a sphere are not, relatively to solid space. The quarrel about the definition of a straight line does not affect the issue in the smallest degree.

22. "I blame making so much, in this way, of the gap 'in the chain of reasoning,' by which the truths of geometry should be logically connected and represented" (p. 109). They *cannot*

all be logically connected. Not one, but several, unproved assumptions must be made before a definite geometry can be constructed. The difficulty does not arise from shortcomings in the definitions, though these are undoubtedly defective. Frame what definitions we please, we must still assume certain *matters of fact*, or *alleged* matters of fact (call them axioms or call them postulates), before we can logically raise the superstructure of the Euclidian geometry. Even if we define straight lines and planes as such lines and surfaces that the propositions of Euclid respecting straight lines and planes shall be true respecting them, even by this extreme procedure we get no nearer the desired goal: for it then remains to be proved that straight lines, planes, parallels, &c., *exist in the space in which we live.* To assume that they do is to assume a whole congeries of axioms. A writer named Thomson once wrote a book called "Geometry without Axioms," which was certainly a desperate effort to get rid of unproved assumptions. The attempted proof of the redoubtable 12th axiom was a perfect labyrinth of intricate propositions; but, like all similar efforts, like any efforts which may be hereafter made to ground geometry on definitions and dispense with axioms, it was but "as the helpless waves that break upon the iron rocks of doom."

The science of the space in which we live is a *physical* and *experimental* science, and, unlike arithmetic, algebra, and all the branches of mathematical analysis (the general theory of manifolds among them), cannot be evolved out of man's inner consciousness.

Art. VIII.—*On a new Form of Seismograph.*

By F. Bull.

[*Read before the Wellington Philosophical Society*, 23*rd September*, 1885.]

The prevalence of earthquakes in New Zealand, and at the same time the uncertainty in the reports from the different parts of the colony, as to their occurrence and direction, owing to the want of proper instruments for their detection, led me to consider the possibility of devising an apparatus which would at once place on record the occurrence of shakes and indicate their direction. Accordingly I set to work, and commenced by planning all sorts of complicated machines, which did not at all satisfy me; and I eventually came to the conclusion that the most simple and direct-acting machine would be the best for the purpose.

The first plan I then adopted was to suspend a heavy sphere of lead, having on its under-side a small tube, fixed vertically, in which a pencil fitted, with freedom to ascend and descend in

the tube like a piston. The point of this pencil rested on the table or base of the apparatus, at the centring point of lines drawn from the four cardinal points. This weight I suspended by a fine brass wire from the centre of a beam, supported on two tall uprights from either side of the wooden table or stand, on the upper surface of which I fixed a paper showing the points of the compass before mentioned. Of course, any motion taking place at the base, such as the movement of an earthquake, would cause a corresponding pencil-mark on the diagram in the direction of the disturbance, it being understood that the suspended weight remained quite motionless; but I had to discard the scheme as being only partially successful, owing to the fact of the earth's motion being communicated (to a certain degree) to the pendulum as well as to the base: whereas, for accurate results, the pendulum should have been disconnected from, and independent of, the diagram, or part which received the earthquake motion.

My next effort resulted in the Seismograph which I have to bring under your notice this evening, and I am pleased to be able to state that I have had proofs that satisfactory results are obtainable from it. You will observe it consists mainly of an inverted basin, heavily weighted round the edge, and balanced on a steel point, the centre of gravity being maintained by means of a disc of steel fixed in the centre of the basin.

The pointed steel rod is firmly fixed in the centre of the stand, which is a substantial wooden one, and from its four sides rise a like number of slight wooden uprights, representing the four cardinal points, and also intended to receive the delineation of the earthquakes as received from the pointers attached to the basin.

On the inner faces of these uprights is fastened a piece of white paper, and over the paper is a piece of sheet glass, the surface of which is smoked over, and the points of the markers rest against this smoked surface. The markers are made of metal, and are hinged to the rim of the basin, allowing the pointed extremities to rest easily upon the glass. A small piece of lead is attached to the under-side of each marker, so as to render the pressure sufficient to keep the point and the glass surface in constant contact. I should mention here that I only use two of the uprights, and have only two pointers, for the reason that one answers equally for the north and south, and the other for east and west, and the use of four would, no doubt, tend to lessen the susceptibility of the instrument.

Having now described the form of the instrument, I will explain its action, though I think but little need be said on this point, as the apparatus is so simple that no doubt you will already have understood its action. In the normal condition of the machine, the rim of the basin preserves a position parallel

to the plane of the base or stand, the markers resting upon the smoked glass, which presents an unbroken dark surface. Now it follows that any alteration in the position of the base, such as an upheaval, or the reverse, of the extremities, as would be caused by an earthquake, must result in a corresponding mark on one or both of the smoked glasses from their contact with the points of the markers, and thus we have the register of the shake. The marks on the glass are rendered the more noticeable on account of the white backing showing through, where the smoke film has been removed.

When I first constructed the machine, instead of rigid metal markers on hinges I used fine wires, bent so as to form a weak spring; and at the points were soft lead pencils, which were to mark the seismic disturbances on a surface of hard drawing-paper instead of glass. But, although fairly successful, I found that after the machine had been undisturbed for any length of time the points had a tendency to settle themselves in the surface of the paper, and a slight shake was not enough to displace them, but the movement became expended in the suppleness of the springs. Accordingly, I substituted the glass surface for that of paper, and the direct-acting hinged markers instead of the springs, and I think we have now an instrument which has the recommendation of being simple in construction, inexpensive, and reliable.

Of course the instrument before you is capable of improvement, in the way of more skilful workmanship, as it is not possible with only a few tools and a kitchen table to turn out very highly finished work; and a real improvement could be effected by substituting an agate centre for the metal one I have used. However, I have, I think, succeeded in producing an instrument, which if properly set up, free from disturbing influences apart from those which its object is to register, will give satisfactory results, and which, from its inexpensiveness and utility, I venture to suggest, might be supplied by the Meteorological Department to numerous stations throughout this colony, and thus allow of a comprehensive and reliable record being kept of the seismic movements so often occurring. I may state that a large number of instruments for this purpose are in use in other countries, and it is only about two years ago that a considerable sum was granted by the Indian Government for supplying all the Meteorological Stations in Bengal and Northern India with instruments. The form of these instruments I have not the least idea of, but I have no doubt that they are much more elaborate, and certainly more costly, than the one I have shown you this evening.

II.—ZOOLOGY.

Art. IX. — *On an "Index-Collection" for small Zoological Museums, in the Form of a Genealogical Tree of the Animal Kingdom.* By T. Jeffery Parker, B.Sc., Professor of Biology in the University of Otago, and Curator of the University Museum.

[*Read before the Otago Institute, 9th June,* 1885.]

The main thing which distinguishes a museum from a collection of curiosities is arrangement. The object of the unscientific collector is to make his cabinet of "curios" look as attractive as possible, and to this end he does not hesitate to mix together stuffed birds, coins, savage implements, eggs, and minerals, for the sake of securing an effective arrangement of form and colour. In a scientific museum, on the other hand, the object aimed at is to place like things with like; to have the minerals, shells, birds, etc., etc., each by themselves, and the individual members of each group arranged according to some definite standard of classification. In this way, the visitor is, as it were, compelled to see the objects exhibited in a definite order, and is thus led to compare not only object with object, but also group with group.

It is, however, obviously difficult to do this thoroughly. In any ordinary museum building it is practically impossible so to arrange the doors, passages, galleries, etc., that the visitor is obliged to traverse them in a certain direction, and so to have forced upon him the natural sequence and grouping of the objects he sees. Moreover, the fact that certain forms of glass cases are suitable to one class of objects, and not to another, often prevents a strictly natural arrangement. For instance, in the Otago University Museum, the necessity for exhibiting both birds and mammals in large wall-cases, has necessitated the former group being placed in the upper gallery, the latter on the ground floor, the lower vertebrates occupying an intermediate position in the lower gallery. Similarly, most invertebrates are, from their small size, best exhibited in flat or "desk" cases, which could only be conveniently placed round the two galleries and between the windows in the lower gallery, in places where wall-cases were inadmissible.

A brief account of the general arrangement of the zoological collection will show clearly enough that, in spite of the plan recently adopted of placing over or in each case labels giving names of the groups represented in it, the natural sequence of the groups is by no means obvious to an ordinary observer.

The general collection of invertebrata extends round three sides of both galleries: from protozoa to brachiopoda in the upper; mollusca and tunicata in the lower gallery. The New Zealand invertebrates are placed in a single row of desk-cases, extending along the west wall of the lower gallery. The fishes, amphibia, and reptiles occupy the wall-cases in the lower gallery; a few of the smaller specimens (fossils, &c.) of the same groups are placed in desk-cases, and a considerable number of spirit specimens on a shelf, extending round three sides of the gallery, above the cases containing the mollusca. Lastly, as mentioned above, the birds occupy the wall-cases of the upper gallery, and the mammals those of the ground floor. Some of the larger specimens of the latter group are placed, not in cases, but in railed-off enclosures, in the centre of the ground floor; and the skeletons of moas and other large struthious birds are, on account of their great size, similarly disposed. In the case of vertebrata, as in that of invertebrata, the New Zealand specimens are kept separate from the general collection.

It is obvious that what is wanted, if the Museum is to be in any way an educational institution, is some contrivance for showing the relations of the various groups of animals to one another, and the place in the Museum where the representatives of each group are to be found. If this is done, the intelligent visitor, who, without time or inclination for exact scientific study, yet wishes to get some notions of natural history, will be guided in his search; and with the aid of a good popular work, such as Miss Buckley's "Life and Her Children," and "Winners in Life's Race," or Cassell's "Natural History," be enabled to acquire a fairly clear and accurate, although naturally superficial, knowledge of the form and general structure of animals, and of their relation to one another.

In the new Natural History Museum at South Kensington, this is done by setting apart the great central hall for an "Index-Collection," in which are exhibited types of the various groups of minerals, plants, and animals. But as the whole of our local museum would go into the hall in question, it is plain that we must be content with something on a very much smaller scale.

To confine ourselves to the zoological collections, which take up by far the greater part of the Museum, it would seem that what we want is a collection in which each of the main groups of animals is represented by one or more examples, and in which these are arranged in such a way as to bring forcibly before the observer the mutual relations of the groups which they typify.

Since the theory of Organic Evolution has been recognized as the central doctrine of Biology, all classification of living things has been founded on the idea of genetic relationship.

From this it seems to follow that the best way to arrange a small index-collection of the kind mentioned in the preceding paragraph, is in the form of a solid phylogenetic diagram or "genealogical tree."*

The model now exhibited is an attempt to carry out the principles just laid down. In it the main line of descent from protozoa to the higher vertebrata is represented by a vertical rod of wood three feet high, about 1½ inches in diameter at its lower end, tapering somewhat towards its upper end, and firmly fixed below into a flat stand about one foot square. The various groups which do not lie on this main line are represented by side branches, which have usually an upward direction, but are inclined downwards from their point of origin in the case of degenerate types. Actual specimens, or, when these are unattainable, models of one or more examples of each group are placed in appropriate positions on the stem and branches, and labels are attached, giving (*a*) the name of the group, (*b*) the name of the representative specimen or specimens, and (*c*) the place in the Museum where the collection of specimens of the group is to be found.

I need hardly say that in the present condition of our knowledge of zoology, the subjective element enters very largely into the construction of a model such as this, and that the progress of research is certain to make alterations in detail necessary. I hope, however, that I have succeeded in representing with some degree of accuracy the mutual relations of the various animal groups.

Near the bottom of the stem is placed a model of an Amœba (*A. radiosa*), representing the myxopodous or pseudopod-bearing section of the protozoa, and a little higher up a model of one of the collared monads, (*Monosiga gracilis*) representing the mastigopodous or cilium-bearing section of the same group. Close to the monad arises an ascending side-branch, bearing on its extremity a specimen of one of the New Zealand fibrous sponges (*Chalinula sp.*) as an example of the Porifera.

A short distance above the Amœba and the monad, on the main stem, the group of Cœlenterata is supposed to begin, and is represented by models of a jelly-fish (*Chrysaora cyclonota*), and of a sea-anemone (*Stomphia churchiæ*), the former being suspended by a wire, the latter placed on a small bracket. From this part of the stem a branch arises, representing the echinoderm phylum, and bearing a specimen of a star-fish (*Asterias forbesii*).

Still higher up the main stem the Type or Sub-kingdom *Vermes*

*My friend Professor Haddon, of the Royal College of Science, Dublin, has devised a most ingenious form of "diagram in three dimensions," excellent for lecture purposes, but less suitable in many ways for permanent exhibition in a museum than the one I propose.

begins; the lower or flat-worms being represented by a model of a planarian (*Stylochus sp.*), the higher or articulated worms by a specimen of a New Zealand *Nereis*, prepared by Semper's dry method. The *Nereis* is placed as if crawling on to a long side-branch representing the arthropod phylum, and bearing specimens of the New Zealand fresh-water cray-fish (*Paranephrops setosus*), and the red-admiral butterfly (*Pyrameis gonerilla*).

Somewhat below the origin of the arthropod branch, and from the opposite side of the stem, springs a branch representing the group of Mollusca, and bearing an oyster (*Ostræa edulis*), and a model of the cellar-slug (*Limax flavus*). Close to the origin of this, two short and slender branches arise from the main stem, one bearing a brachiopod (*Terebratella vitrina*), the other a polyzoon (*Retepora cellulosa*).

A few inches above the worms, the vertebrate (or chordate) phylum is supposed to commence. Two descending branches, arising near together, represent the degenerate groups of the Tunicata (*Urochorda*) and Acrania (*Cephalochorda*): on the Tunicata branch is placed a model of a simple ascidian (*Microcosmia pyriformis*); from the end of the neighbouring branch is suspended a model of the lancelet (*Amphioxus*).

A short distance higher up the stem is another descending branch, on which is fixed a stuffed specimen of one of the New Zealand fresh-water lampreys (*Geotria chilensis*), representing the probably degenerate group *Cyclostomata*. Above this begins the lowest group of gnathostomatous vertebrata, the class *Pisces*, represented by a small specimen of the common New Zealand dog-fish or smooth hound (*Mustelus antarcticus*) suspended from the main stem. Still higher, also suspended from the main stem, is a specimen of the axolotl (*Amblystoma tigrinum*) as an example of the Amphibia.

A little above the place of attachment of the axolotl, the vertical stem comes to an end as such, dividing into two opposite branches of unequal length, the shorter representing the Sauropsida, the longer the Mammalia. On the proximal end of the shorter branch, representing the Reptilia, a specimen of the New Zealand spotted lizard (*Mocoa grandis*) is placed, close to the fork, and with its tail winding round the upper end of the main stem. On the distal extremity of the shorter branch is perched a New Zealand parrakeet (*Platycercus novæ-zealandiæ*) as a representative of Birds, while in a corresponding position on the longer branch is a marmoset (*Hapale jacchus*) as an example of Mammalia.

The labelling is an important feature of the model. For each group—type, or class, as the case may be—a label is provided giving the scientific and English names of the group, and of the species chosen to illustrate it, and indicating the place in the Museum where further examples of the group are to be

found. Two examples will illustrate the method of labelling adopted :—

Type ARTHROPODA,
Including Crayfishes, Crabs, Centipedes, Spiders, Insects, &c.

Examples :

1. The Fresh-water Crayfish (*Paranephrops setosus*).
2. The Red Admiral Butterfly (*Pyrameis gonerilla*).

General Collection.—Upper Gallery, N. and S. sides, Desk Cases 18—38; Spirit Specimens on shelf above cases.
N.Z. Collection.—Lower Gallery, W. side, Desk Cases 5—11; Spirit Specimens on shelf above cases.

Class AVES (Birds).

Example :

Red-fronted Parrakeet (*Platycercus novæ-zealandiæ*).

General Collection.—Upper Gallery, Wall Cases on E., W., and S. sides; Skeletons of Ostrich, &c., on ground floor, South enclosure.
N.Z. Collection.—Upper Gallery, Wall Case on N. side.
Moa Remains.—Ground Floor, S. enclosure; Upper Gallery, Desk Cases 41—43, and small wall case at S. end.

I am aware that several objections may be made to the construction of this model. From the strictly scientific point of view, undue prominence is given to the vertebrata, while many interesting invertebrate groups are omitted altogether. But this is done purposely: the vertebrata must of necessity occupy a far larger share of museum space, and attract more attention, than invertebrates; so that it is, I think, advisable to call special attention to the classes of vertebrates, while the invertebrata may well be considered by sub-kingdoms or types. Again, the retention of the type *Vermes* is a sacrifice of strict accuracy to convenience; but the curator of a small colonial museum may be pardoned for sinning, in this matter, in company with Professor Claus, in whose text-book (English Edition, vol. i., p. 303) the same conventional union of the various and divergent worm-classes is made.

It is also incorrect to place any existing species, or indeed any existing lesser group, on the direct line of descent of the higher animals. For instance, it is tolerably certain that none of the ancestors of existing birds and mammals would, if discovered, be classifiable with any of the existing subdivisions, either of fishes or of amphibia; but it is none the less certain that what may fairly be called piscine and amphibian stages must have been passed through.

As a final objection, it may be said that a more correct mode of construction for a model of this kind would be to make the branches of such a length as to bring the ends of all of them, and consequently the specimens they support, to one level: advance of organization would then be indicated, not by height above the ground, but by distance from a centre, and all but the

distal ends of the branches would represent extinct forms. But such a model would be far less convenient than the one I have adopted.

In spite of these and other obvious objections in detail, I think the model may be considered as showing, fairly accurately, the main facts of zoological classification. For instance, it illustrates the impossibility of making a linear classification of animals: it shows the futility of discussing whether molluscs are "higher" or "lower" than arthropods, both being shown to have arisen from comparatively low worm ancestors, and to have reached a high level of organization along totally different lines: it shows how, by degeneration, Amphioxus, although a vertebrate, has sunk below the level of organization of many invertebrates, and is as much below an ordinary fish as a fish is below a man: it further illustrates the now established fact, that while the two lowest groups of gnathostomatous vertebrates — fishes, and amphibia — lie, speaking generally, in a linear series, the higher groups diverge in two opposite directions, birds springing undoubtedly from reptiles, mammals either from archaic reptiles or from some unknown group intermediate between reptiles and amphibia.

One advantage of the model I must not fail to mention: its construction is simple enough to allow of comparatively easy alteration in the place of origin or direction of the branches, whenever the progress of zoology necessitates a change in our view of the relations of any group.

Art. X.—*Notes on a Skeleton of* Notornis, *recently acquired by the Otago University Museum.*

By T. Jeffery Parker, B.Sc., C.M.Z.S.

[*Read before the Otago Institute, 11th August, 1885.*]

Some months since I was informed by Mr. Edward Melland that the skeleton of a Takahe had been found on his station, near Lake Te Anau, by Mr. Richard Henry, who, having a strong taste for natural history, had recognised the bones and carefully collected them.

The specimens were forwarded to Dunedin, and Mr. Melland was good enough to bring them to the Museum for my inspection. As the more important bones were present, and in very good preservation, I was glad to be able to purchase them, and thus to make a very important addition to the collection of native birds.

As is well known, the only recent remains of *Notornis* hitherto obtained are the two stuffed specimens in the British

Museum, procured by Mr. W. Mantell in 1849, and the skin and skeleton of a bird caught alive near Lake Te Anau in 1879. I had the honour of exhibiting the two latter at a meeting of this Institute on 6th April, 1881, and, at a subsequent meeting, of reading a paper on the skeleton.* Both skin and skeleton were sent to England for sale, and were purchased by the authorities of the Dresden Museum for £110.

Besides the above-mentioned specimens, the only remains of *Notornis* of which I am aware are the fossil bones in the British Museum, upon which the genus was founded by Owen.†

The Te Anau specimen of 1879 naturally attracted a good deal of attention in Europe. It was exhibited by Professor Newton at a meeting of the Zoological Society, on 17th January, 1882,‡ and subsequently furnished the subject of a paper by the first describer of the genus, Professor (now Sir Richard) Owen.|| After its purchase for the Dresden Museum, the skeleton was briefly described by the Director, Dr. A. B. Meyer, his account being accompanied by a series of measurements, and by four beautifully executed autotypes.§ The latter, I have had framed for exhibition in this Museum, and am thus enabled to exhibit them to-night for comparison with the actual skeleton.

The bones which form the subject of the present communication were found, (as stated by Mr. Henry in a letter to Mr. Melland,) in a small patch of scrub, about half a mile to the east of Patience Bay—the southernmost arm of Lake Te Anau. The surrounding district consists of low-lying fern and tussock country, and the patch of scrub in which the bones were found contains a few mapau (*Pittosporum tenuifolium*) and "lawyer" (*Rubus australis*) bushes; some miko-miko (*Aristotelia racemosa*) and manuka (*Leptospermum scoparium* and *L. ericoides*), and an acre or two of rushes (*Juncus*, various species). Within a hundred yards of the scrub a small creek arises, and discharges into the lake. The pelvis, vertebræ, etc., all lay on an area not larger than a sheet of writing paper, but one of the leg bones was found thirty feet away, quite outside the scrub, and other bones six feet from the main heap. One would imagine that rats caused this dispersal of the bones, and the consequent incompleteness of the skeleton.

Mr. Henry also states that the skeleton of 1879 was found at the edge of a patch of bush, about 200 acres in extent (locally known as the "Wilderness"), situated immediately to the north

* "Trans. N.Z. Inst.," vol. xiv. (1881), pp. 245, 561, and 562.

† "Extinct Birds of N.Z.", pp. 173, 196, 199, and 436; and "Trans. Zool. Soc.," iii., p. 366; iv., p. 12; viii., p. 119; and vii., pp. 369 and 373.

‡ "Proceedings Zool. Soc.," 1882, p. 97.

|| Ibid., p. 689.

§ Abbildungen von Vogel-Skeletten, iv. and v. Lieferung. Dresden, 1883.

of the Mararoa river, about 3½ miles east of Whitestone river, a tributary of the Mararoa, and 9 miles south-east of the extreme south end of Lake Te Anau. The name, "Bare-patch," applied by Dr. Buller to the locality,* does not seem to be in general use, since it is unknown both to Mr. Melland and to Mr. Henry, both of whom have known the district for several years.

The Dresden and Dunedin specimens of *Notornis* were there found, not more than 8 or 9 miles apart.

The skeleton, as it reached the Museum, consisted of the following bones:—

The skull and lower jaw.	Both femora.
The sternum.	Both tibiæ.
The left coracoid and both scapulæ.	Both fibulæ (one broken).
Both humeri.	Both tarso-metatarsi.
The right ulna.	One of the proximal phalanges, probably that of the 3rd left toe.
The coalesced 2nd and 3rd metacarpals of the left side.	Six cervical vertebræ.
The pelvis.	Seven thoracic vertebræ.
	Five ribs, more or less broken.

The skull is the most interesting part of the skeleton, since in the North Island fossil the brain-case and beak were separate, and both of them more or less broken, while in the Dunedin specimen the occiput was completely destroyed to allow of the removal of the brain. In the present specimen both quadrates and pterygoids are missing, and the left jugal arch is broken, but in other respects the skull is perfect.

The mandible is also quite perfect, and the sternum and pelvis nearly so. The right fibula is broken, only the proximal half being left, but the other limb bones are quite uninjured, as also are the scapulæ, the coracoid, and the vertebræ.

From an examination of the Dresden specimen, Meyer has concluded that the *Notornis* of the South Island, represented by the stuffed specimens in the British Museum and by the Dresden skin and skeleton, is specifically distinct from the North Island form, represented by the original fossil bones. As it was upon these latter that the species *N. mantelli* was founded, Meyer proposes to form a new species, *N. hochstetteri*, for the Southern form. The differences relied upon are in the proportions of the leg bones, which are as follows:—

	N. hochstetteri.	*N. mantelli.*
Femur	10·9 cm.	12·2 cm.
Tibia	16·5 ,,	20·0 ,,
Tarso-metatarsus	10·0 ,,	12·9 ,,

Judging from the minute differences of plumage, etc., which are considered to be of specific importance by ornithologists, one is disposed to concur in the formation of the new species,

* "Manual of the Birds of N.Z.," p. 65.

however much one may regret the restriction of a well-established and widely-known name.

From the point of view of zoo-geography, it is decidedly interesting to find *Notornis*, like *Orthonyx*, *Petrœca*, *Turnagra*, *Glaucopis*, *Ocydromus*, and *Apteryx*, represented in the two Islands by distinct species.

On comparing the bones of the present specimen with the published figures of Owen and of Meyer, the only matters I consider to be worth mentioning are one or two points of difference in the skull.

In both the Dresden and Dunedin specimens the beak presents a somewhat stronger downward curvature than in Owen's specimen, and the nasal aperture is slightly smaller. A more obvious, although still comparatively unimportant, difference is seen in the relations of the well-marked ridges which bound the temporal fossæ above and behind. The distance between these ridges, or in other words the width of the flattened roof of the skull in the parietal region, is very markedly less in the Dresden and Dunedin specimens than in the North Island fossil figured by Owen, the proportion being about 2 : 3. In the latter, also, the ridge in question forms a very even curve, whereas in both the Te Anau skulls there is a distinct angulation at the junction of the supra-occipital and the parietal. This may be expressed differently, by saying that the temporal muscles are larger in *N. hochstetteri* than in *N. mantelli:* whether the difference is one of age or of sex it is of course impossible to say, but all three skulls appear to be fully adult. The distance between the temporal ridges, at the narrowest point, is 21·75 mm. in Owen's figure, 13·5 both in Meyer's figure and in the present specimen.

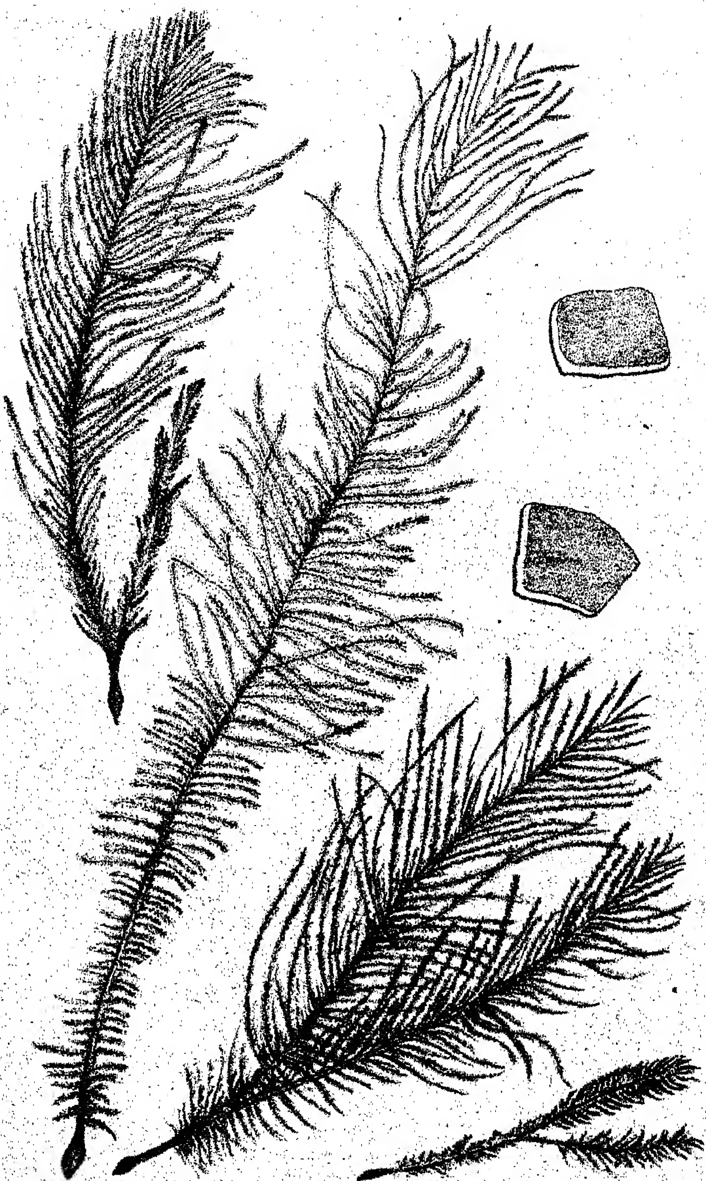
Whether an ornithologist would consider a difference of this nature of any importance I cannot say: as far as it goes, it tends to support Meyer's view of the distinctness of the Northern from the Southern *Notornis.*

In conclusion, I give a series of comparative measurements of the Dresden and Dunedin specimens. I may mention that certain discrepancies between the measurements of the Dresden skeleton, as given by Meyer and by myself in the paper referred to above, are due to the fact that Dr. Meyer has—no doubt, correctly—given in every case the greatest length of the bone, whereas I have given the length of a median longitudinal axis. This makes a great difference, especially in such bones as the sternum. In the following table the measurements are taken so as to compare exactly with Meyer's:—

Skull.—	Dunedin Specimen.	Dresden Specimen.
Length from posterior surface of occipital condyle to end of beak	98 mm.	..
Greatest breadth	45 ..	45 mm.

	Dunedin Specimen.		Dresden Specimen.
Humerus.—			
Length	90	..	87·5
Breadth of head	21	..	23·5
,, ,, condyles	15·5	..	18
Circumference of shaft	19·25	..	16
Ulna.—			
Length	75	..	75·5
Breadth of proximal end	14	..	13·8
,, ,, distal end	9	..	8·7
Metacarpals.—			
Length	46·5	..	46
Femur.—			
Length	109	..	109
Breadth of proximal end along axis of neck	25	..	27
Breadth of distal end	22·5	..	27
Circumference of middle of shaft	34	..	34
Tibia.—			
Length	165	..	165
Breadth of proximal end	32	..	31
,, ,, distal end	18·5	..	22
Circumference of shaft	29·5	..	29
Fibula.—			
Length	108	..	112·5
Breadth of proximal end	11·5	..	12·2
Tarso-metatarsus.—			
Length	98	..	100
Breadth of proximal end (transverse) ..	19·5	..	22
,, ,, ,, ,, (antero-posterior)	21·5	..	24·3
,, ,, distal end	21	..	23
,, ,, shaft	10·2	..	10
Sternum.—			
Greatest length	74	..	75·5
Length of median longitudinal axis ..	62*	..	66
Height of keel	9	..	8
Coracoid.—			
Greatest length	47	..	43·5
Scapula.—			
Length in a straight line	74	..	74·5
,, along the curve	80	..	80
Breadth of middle	5	..	5
Pelvis.—			
Greatest length	116	..	130
,, width	54	..	55
Width of sacrum	23·5	..	23

* The middle ziphoid process is broken in this specimen.



M.E.W. del.

To illustrate Paper by T. White.

Art. XI.—*Remarks on the Feathers of two Species of Moa.*

By Taylor White.

[Read before the Hawke's Bay Philosophical Institute, 14th December, 1885.]

Plates II. and III.

The accompanying plate (No. II.) contains copies of three Moa feathers, and pieces of egg-shell, found with others in a cave on the shores of Lake Wakatipu, Otago, and mentioned in vol. viii. of "Trans. N.Z. Inst.," p. 98.

The feathers are drawn to scale. The larger one is pure white, and was the only white feather amongst those found, and also the longest.

The feather to the right is in colour like the majority of those found, some of which were an inch longer, others longer and slighter; others again much smaller, and nearly all double-shafted.

In colour, the shaft and centre has a bright transparent yellow, as of gum or resin, changing to dark purple brown on the outer margin of feather. They have probably all been duplicated, the duplicate feather being joined to the principal in what I may call a quill socket, which corresponds with the depth to which the feather entered the skin of the bird; the duplicate feather being slightly shorter, and one-third less in width than the principal.

The left-hand feather represents a third type, which were not so numerous, and all of medium length; they were mostly wanting or denuded of the duplicate shaft. In colour, a dark reddish or chestnut purple; the shafts, more opaque than the above-mentioned, were of a lighter and redder colour than the outer and tip.

These were most likely breast feathers.

The colour of the bird must have been of a most delicate mixture, a foundation of shining yellow outwardly, shaded with dark purple brown, the breast a chestnut purple; and, to locate the white feather, say white on the after part of the back, which cannot rightly be called the tail, as the rump would be covered with drooping hair-like feathers.

The bird would, from the slender make of the feathers, have the appearance of being covered with long flexible hair, and not with immovable armour, showing only the outer colour of the feather as in ordinary birds. From this flexibility, I infer that the golden colour of the centre part of the feather would be visible in the plumage. It was probably about 3 feet 6 inches in height; and, from a metatarsus found in the same cave, is considered to have been *D. casuarinus*.

Several pieces of egg-shell of a light green colour were also found, in what appeared to have been a nest, and are shown on plate II.

The colour of egg-shell is green. This specimen was obtained from sand-drift on the Kawarau River, Otago, and inclines to the presumption that the colour has been bleached out in most of the fragments of egg-shell which are found, any other specimens which I have collected showing no sign of colour. Yet amongst these white shells there is a marked difference in the form of the pit marks or pores of the shell, showing they are different varieties.

Plate III. contains copies of feathers collected from a small cave near Queenstown, Otago, which are mentioned in vol. viii., page 99, "Trans. N.Z. Institute."

These feathers show a considerable quantity of light-coloured down. The longest was a little short of six inches.

They are of at least three classes: First, the longer are narrow and mostly duplicate, a thick light-coloured down extending two-thirds along the shaft; a dark purple brown at tip, the colour lighter at base and along shaft. The second are shorter, wider, and more robust; two-thirds, a thick down, colour darker. A third class, two to four inches long, are probably neck feathers, and are of a more translucent and hairy texture, showing no down and few barbs, the shorter inclining in colour to yellowish brown, others to nearly black.

From the style of these last, the upper part of the neck and the head of this bird were most likely without feathers.

The green egg-shell shown in this plate was found in drift sand on the Kawarau River.

Art. XII.—*Notes on New Zealand Ornithology*: *Observations on* Pogonornis cincta *(Dubus)*; *Stitch-Bird* (Tiora).

By A. Reischek, F.L.S.

[*Read before the Auckland Institute*, 1st *June*, 1885.]

The first specimens of these birds I saw in the Canterbury Museum (two males, set up). On inquiring, Dr. von Haast informed me they were very rare. The next brought under my notice was a male specimen, in the Auckland Museum; and Mr. Cheeseman told me Professor Hutton, C.M.Z.S., mentioned them as not uncommon on the Little Barrier or Hauturu Island, in the Hauraki Gulf, for which place I started in October, 1880, accompanied by my friend Mr. E. Firth, for the purpose of

M.E.W. del.

To illustrate Paper by T. White.

ornithological researches, and especially with the object of studying the habits of these birds, which I may here mention I have never seen or heard on the mainland or other surrounding islands.

After searching the western and south-western parts of the island, I was unsuccessful in seeing or obtaining a single specimen. I intended penetrating in to the centre, but was informed by the Natives that it was impossible to get overland to the east coast on account of the many precipices, and that the sea was too rough to permit of my landing on that side; so I returned to Auckland, with the intention of resuming the search at another time.

In May, 1882, Mr. Dobson, a friend who has accompanied me in several of my journeyings, preceded me to the same island, for the purpose of repairing old huts and building new ones, taking provisions for a prolonged mountain expedition, my intention being to follow him in June; but, owing to boisterous weather, after making two attempts to land, and having to give it up, once in the *Water Lily* after five days' cruising, and once in the *Rangatira* after three days', I put off my trip till October, on the 15th of which month I succeeded in landing. The first night we camped at the foot of a precipice, the ascent of which we commenced at three o'clock next morning. To give an idea of the difficulty of climbing here, I had to pull my dog (a good Alpine traveller,) up with a rope, in addition to our provisions, &c. After this we climbed over two ranges, each above 2,000 feet high, arriving at an old nikau whare, which my friend had previously built, at the foot of the last range. It was dark before we finished mending the roof and preparing for a start the next day. On the morning of the 23rd, I first heard the whistle of the Stitch-bird: I was unable, however, to get a glimpse of it; and though we cut tracks to the tops of most of the main ranges, and afterwards frequently heard the birds, could never see them. Later experience has taught me that their shrill whistle is very deceptive, and the sound travels a long distance.

I then shifted my quarters further towards the interior; and on the 25th, my attention was arrested by the call of my dog at a short distance. On going towards him I saw a male Stitch-bird hopping about in a very excited manner in the scrub above him. I was so interested in watching this beautiful bird (which has a brighter plumage than any of its New Zealand compeers), with its quick and graceful movements, that it disappeared before I attempted to use my gun.

Though constantly exploring, I never saw another specimen till the 7th November, yet frequently heard them. Early on that morning we travelled north-west to the top of a high, narrow range of precipices, overgrown with short thick scrub

and manga-manga, which made it so dense that I had to cut the way with my hunting-knife. This place I found a favourite resort of these birds, (which have cost me so much time, labour, and patience,) having a warm aspect, exposed to the sun. There I saw male and female, the latter for the first time; but, unfortunately, my friend was carrying the gun, and before he could hand it to me, both birds had disappeared. On the 8th November, I saw a male at the same place, and on going over a range I heard another; subsequently I went round it, and saw male and female near a nest, and endeavoured to observe them unnoticed, but they quickly saw me, and in the act of escaping I shot them. I then went and examined the nest, which was only half finished, built of very small branches, roots, and fine native grass, and lined with hairy substance off the fronds of the *punga*.

In December, 1883, in the centre of the island, I observed a pair of adults with three young birds. On the male noticing me, he uttered a shrill whistle, and the female immediately hid amongst the fern for a considerable time. I procured several specimens; of which I gave Dr. Buller a male, female, and young. I have only once seen these birds sitting still, and that was near the nest. They appear always on the move, carrying their heads proudly, their wings drooped, and their tails spread and raised; and, at each successive movement, they utter that peculiar whistle from which the Natives have named them "*Tiora.*" The female has a different note, sounding like "*tac, tac, tac,*" repeated several times. They feed on small berries and insects, and suck the honey from the native wild-flowers and trees, as many of the latter exude honey during the night. In fine weather I have found them on the mountains between precipices, in low scrub, where the aspect is warm; but in bad weather, lower down in the gullies, in places entangled with numerous creepers. They are not strong on the wing, but very active in hopping and climbing, which enables them to quickly escape from sight.

The plumage of the male is as follows:—Head and neck, shining velvet black, with a few long silvery white ear-feathers; shoulders, golden yellow; upper secondary, white, with brownish black points, and a slight splash of white under the wing covers; wings and tail, brownish black, each feather edged on the outer side with olive green; tail cover, greenish tinge, and a yellow band round the breast; abdomen, greyish brown; bill, black; eyes, dark brown; feet, light brown. The female is a little smaller than the male, of olive brown colour on the top of the head, back, wing, and tail, each feather being shaded with olive green; shoulders, yellowish; upper secondary, white, with yellowish brown shade, ear feathers hardly perceptible, under part brownish grey; bill, legs, and eyes same

as male. So far as I know, the plumage of the young, which differs from that of the adult bird, has never been described :—

Measurement.

Male ..	.. L. 7·50	.. W. 4·25	.. B. ·69	.. T. 1
Female	.. L. 6·75	.. W. 3·75	.. B. ·69	.. T. 1

I landed on my last expedition on the 8th April, 1885, returning in May, during which time I went to the centre of the island, where I knew their favourite resort, to obtain some specimens for the use of the New Zealand museums. I was then successful in observing a pair feed their young, (two males and one female,) which must have been a late brood. I also shot some, shedding their first plumage, as per specimen shown, the yellowish band round the chest beginning to show, also the white ear feathers, and the throat, neck, and head changing from grey to black. When very young, the male is of similar plumage to the female, except the yellow shoulders.

These very rare birds will soon disappear, even from these lonely wilds, owing to the domestic wild cats, which are very numerous, and commit great havoc among them, and also the Sparrow-hawk (*Hieracidea novæ-zealandiæ*) and "Morepork," (*Athene novæ-zealandiæ*) in whose crops I have often found their remains.

Art. XIII.—*Notes on New Zealand Ornithology: Observations on* Procellaria parkinsoni (*Grey*), *Brown Petrel* (Taiko).

By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 27th July*, 1885.]

These birds are found round the coast of New Zealand; I have seen them over a hundred miles from land, cruising about in a similar manner to, and in company with, the Albatross (*Diomedea exulans*), but they never go near enough to a vessel to be caught, nor do they pick up the food thrown overboard, as the Albatross does. This Petrel is gregarious, and I have seen them in large flocks together, resting on the water. Their power of flight is marvellous. In July, 1879, outside the Kaipara, on the west coast of North New Zealand, I had an opportunity of observing these birds, having to lay by outside the bar for several days, being unable to enter, as it was blowing one of the severest gales experienced in these seas; they cruised about, dipping the points of their wings at intervals in the water, then suddenly swooping down through the foaming waves for their prey; rising with the next wave, and repeating their former action. From July to November these birds are always out at sea. In November they come ashore to their breeding places, on the top of high and

steep mountains, which they choose for the purpose of easier flight, as they have difficulty in ascending from the level ground.

They are expert climbers; I saw them, by the aid of their sharp claws, their bill, and wings, climbing up trees out of the perpendicular, from whence they flew away. In November, 1882, on the eastern slope, and near the centre of the Little Barrier or Hauturu Island, situated north of Auckland, at about 2,300 feet above sea level, on a steep precipitous ridge, I noticed my dog repeatedly setting at burrows, which, on examination, I found contained *Procellaria parkinsoni;* they were cleaning out their old burrows; and, staying to observe, I noticed them digging with their bills, removing the earth by a backward motion of their feet, till the burrow was cleansed. In most cases I found them working, in others the burrows were clean and the refuse outside; some burrows in loose soil, others under the roots of trees and under stones, also in hollow trees. I have found them sometimes very far inland, always on the tops of mountains.

In December, 1884, on the Waitakerei Ranges, 1,000 feet above sea-level, and twelve miles from the ocean, I found the female sitting on an egg, nearly hatched. I measured several burrows of these birds, the entrance was from 8 to 12 inches in diameter, the depth from 1½ to 2½ feet, and the height about 1 foot. When they have finished cleaning out the burrows, which process male and female accomplish together, they remain quietly till the last rays of the sun have disappeared, then any one can hear them call, which is similar to the Black Swan (*Cygnus atrata*), and, on coming out, they stop a moment, pick up a few leaves or grass, and go back into the burrows; this they repeat several times, and always on entering the chamber they make a peculiar noise together. After dark both come out, rise and circle round, calling until they attract others, and when a large flock is assembled they fly away to their haunts on the ocean, returning before daylight. At this season, before they lay, they are very fat. When caught, on their return from the ocean, if they cannot protect themselves by scratching and biting, they expectorate a lot of oily matter on their assailant. The first time I caught one of these birds it treated me in this manner. As soon as they have finished building their careless nest, which is a deepening in the chamber, with a few leaves in it, the female lays one white egg about the size of that produced by a Brahma fowl. When the female lays, the male separates from her during the day, while she is hatching, and remains in a separate burrow of his own not far away. The first egg of the *Procellaria parkinsoni* I found on the 28th November, 1882, at the Little Barrier. After this date I found and examined several, but never found more than one egg or young in a nest, and the female always sitting on the egg.

I watched these birds by moonlight, and have seen the male come out of his burrow and fly away; returning after a time, and circling round in the air, he swooped down to the burrow of the female, striking the ground with a force that could be heard some distance. He stopped outside a little, then entered, and I heard a whimpering noise. After this a bird came out and flew away, returning after a time to the same burrow, and in a few minutes once again emerged and flew away; but returned before daylight, and using the same precaution on entering as before. Then one bird came out and went to the second burrow. I examined the burrow where this process was going on, and on putting my hand in it was severely bitten, which was repeated on my trying to lay hold of the bird, which drew back into the chamber. So I dug with a tomahawk till I reached where the bird was sitting, and tried to take the egg from under it, which I partially succeeded in doing, when I was again so severely bitten that I had to let it go. As soon as I did so, the bird with its bill rolled it back into the nest. I protected my hand, and then took the egg, which was quite fresh. My dog went to the bird, which attacked him furiously. On examination I found this was a female. I then went to the other burrow, where I saw the bird go in. This bird defended itself in the same plucky manner. There was no egg in this chamber, and on examination I found this bird was a male. About the end of December I found a female in a burrow, with one small chick covered with grey down, which she defended furiously. I have also found very young birds in January, even as late as April. As soon as the young birds are a few days old, the parents leave them in the burrow from before sunrise till after sunset, while they go to seek food. On their return, they circle round the burrow as before, stopping at the entrance to call, which the young birds immediately answer. After entering they make a whimpering noise. The old birds leave and return several times in a night. Once or twice only have I found adult birds in the burrow during the day, when they had their young; the reason being that, not having left the burrow before daylight, they are afraid to leave till evening. If they find their burrows disturbed they will not go in.

The Natives are very careful, when taking the young *Taikos*, not to disturb the burrows. They make expeditions in May to the islands where these Petrels are breeding. In former times each tribe had their ground, which they visited every year, and defended obstinately against the intruder. The birds were taken out with a flexible stick, pointed at one end and split, which was pushed into the burrow till the bird was felt, when they twisted the stick round in the down and pulled out the bird gently; then bit the head, to kill it. They then took the bird's bill, to cut the skin under the crop, and pulled out the

oil-bag, which was thrown away, as the oil would spoil the flesh for food. They pluck each bird as they get them, and when a large number are obtained carry them to the camp, where they singe the down off over a fire; then they roast the bird until the fat is extracted, and, placing them in a vessel made of totara bark, they cover them with the fat to keep them air-tight. When preserved in this manner they keep a length of time. I saw the Natives very often preserving them during my researches in the King Country, beginning of 1882; and have eaten and found them excellent. If the Natives disturb any of the Petrels' burrows, they always restore them. These birds, which were very numerous on the Little Barrier Island during the breeding season, I found on my last visit (April and May, 1885), had become very scarce, but I found the remains of many which pigs and dogs had destroyed.

I procured specimens, as you see here: adult, young of different ages, and egg.

Art. XIV.—*Observations on Gould's Petrel* (*Hutton*), Procellaria gouldi (Ohi), *their Habits and Habitats.*

By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 27th July*, 1885.]

These Petrels are common on the coast of New Zealand. I saw them in large flocks out at sea, where they remain from March till August; in the latter month they come ashore to their old breeding places, which they use annually as long as they are not molested. These birds breed in colonies: their burrows are sometimes very close to one another; on the Little Barrier Island (or Hauturu Island) I measured a piece of ground 36 feet in circumference, in the centre of which were six burrows. Their breeding resorts are always on the cliffs along the coast, and some are very difficult to approach, dug out by these Petrels even in hard sandy formation or clay. In August, male and female begin to clean out their old burrows, or dig fresh ones if the former have been disturbed, in a similar manner to the *Procellaria parkinsoni*. The burrows are from 1½ feet to 4 feet apart; the entrance 6 to 10 inches in diameter, the passage in most cases winding, and from 2 to 4 feet deep. The chamber is from 1½ feet to 2 feet wide, and from 6 inches to 1 foot high; in it is a deepening, with a few leaves and grass, which forms the nest. In the beginning of September the female lays one white egg, the size of that of a common fowl; they very seldom lay two eggs. The female hatches the egg, and the male roams about the ocean in the daytime—sometimes I found them ashore, in a separate burrow from that of the female.

After sunset, thick clouds of these Petrels swarm round the cliffs, uttering the melancholy sound "*ohi! ohi!*" from which the Natives named it "*Ohi.*" Each one circles round its burrow several times before it goes down to it; then they stop for a moment before entering. These birds go to and from their burrows several times a night. When the young is hatched, the female stops for a few days with her chick in the burrow; after that both parents leave every morning before sunrise, and fly to their haunts on the ocean. Returning after sunset, they circle round the burrows, then swoop down to the entrance and call: when answered by the young bird, they enter. If both birds come to the burrow together, one stops outside till the other reappears. When feeding the young they make a whimpering noise. Male and female rear the young together, and defend them; but they are not so vicious as Parkinson's Petrel. In February the young are full-grown, and very fat; the Natives go to collect and preserve them, in the same manner as I have already described in a former paper.

If any of these birds have to be preserved for scientific purposes, great care must be taken to catch the bird by the bill, and hold it tight together until it is killed; then dry sand or earth must be put in the bill, and the neck tied with a string or flax. If these precautions are not taken the birds disgorge an oily substance at the intruder, and over their plumage, which renders them useless. The old birds do the same, if caught directly after their return from the ocean. This oily matter is mostly taken from the Octopus (cuttle-fish), of which I found the remains in their crops. When I was observing their breeding-place in 1882, on the Little Barrier, one of these birds went circling round, but on noticing me would not come down, and kept on calling. I heard the young bird answering from a burrow: when I approached she was instantly quiet. Being a beautiful moonlight night, I went a short distance away to watch. Presently the parents descended, stopped outside the entrance, and went away. The next night I went to my post early, so as to be there before the birds returned from the ocean. When they arrived they circled round as usual, swooped down, and entered the burrow. In July and August, 1882, hundreds of these Petrels were washed ashore on the islands on the East Coast, either dead or exhausted, and were eaten by the wild pigs. I dissected several, but I could not ascertain any other cause of death than the severe storms which raged previously. I never found these Petrels inland, and they have decreased in numbers. I even saw them rooted out by pigs and dogs, on the cliffs, where only narrow ledges led to them. I procured specimens, as you see here: adult, and young.

Art. XV.—*Observations on Cook's Petrel* (*Grey*), Procellaria cooki (Ti Ti), *their Habits and Habitats.*

By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 24 August,* 1885.]

This pretty little Petrel is not so common as the previous species, according to Dr. Buller, F.R.S., etc.; there have been only a few specimens obtained, and very little is known of their habits, but I have succeeded in observing them carefully. The first time I met with this bird was in December, 1880, on my second research at the Chickens or Morotiri Islands, on the western slope of the larger island, along with the Tuatara (*Sphenodon punctatum*), in one burrow. Professor von Haast, F.R.S., etc., read a paper of mine before the Philosophical Society, Christchurch, on the latter (see "Transactions, N.Z. Institute," vol. xiv). On the north-eastern portion, near the centre of the Little Barrier or Hauturu Island, in October, 1882, my dog set a burrow; and on digging into it, I was surprised at finding a pair of these Petrels also on this island; they came ashore to clean out their burrows, which process is accomplished with their bill and feet, as I have already described in a previous paper. I measured several of their burrows, and found the average width at the entrance from 4 inches to 6 inches in diameter, and from 4 to 8, and even 12, feet from the entrance to the chamber, of which I always found two in each burrow, and which were from 1 foot to 1½ feet long, 1 foot deep, and from 6 inches to 1 foot high; in each chamber is a hollow filled with leaves, moss, or fine grass. I found these burrows even in the stiffest clay, winding about roots and stones. I often worked half a day, and then had to give it up without success. Male and female mutually assist at cleaning out or making fresh burrows. After sunset they begin to call like "*ti, ti, ti*," repeated rapidly, which is the signal to assemble for their departure to their ocean haunts, from which they do not return till before sunrise; this process goes on nightly till their burrows are cleaned out and the nest made. I built a hut in the centre of the Little Barrier, near one of these burrows, on purpose to make a closer observation of these rare birds. The 1st November, when they returned as usual, early in the morning, I noticed that they made a peculiar noise in their burrows; in about half-an-hour one came out and stopped for a moment, then flew away, and did not return till after sunset, when he flew several times round above the burrow, and then went off again, not returning till next night, when he went into the burrow and made the same gurgling noise as before; after a while a bird came out and flew away, which returned before

sunrise and went into the burrow. After some time one came out, and again flew away. I then examined the burrow, and found a bird sitting on an egg; on dissecting the bird I found it was a female. I never found more than one egg, and always the female sitting on it; the male I have found not far off in a burrow by himself. When the young are hatched, male and female rear them together, and defend them pluckily; the young are full-grown in March, when the Natives collect them for food; the flesh of this species of petrel being the most esteemed by them.

When on shore, the habits of these birds are nocturnal; their breeding places are in the mountains in the interior, they do not breed in colonies as the previous species. When swooping through the air, they make a noise with their wings like the hiss of a bullet speeding through the air. On dissecting the crops of these Petrels I noticed a peculiarity: the absence of oily matter or remains of fish, which is common in most of the *Procellaria* family. I found animalculæ, minute seeds, and sea-weed. In my opinion this Petrel is not destructive to fisheries.

The young of all the species of *Procellaria* could be made use of for food, if properly prepared. In former times the Natives had, to a great extent, to depend on these birds, and made long expeditions to collect them; the manner of which I have already described in a former paper read before this Institute. I am sorry to say I have found them every year decreasing. When I went on my seasonal researches on my last trip, 1885, on the Little Barrier, I could not see a single specimen of this Petrel; and of the other four species I found numerous on my first visit I found only a few, but plenty of remains such as wings, feathers, etc., destroyed by wild cats, Native dogs, and wild pigs. In former times the Natives protected their breeding places carefully; but now, as they have plenty of other food which is easier to be got, they are left to destruction in all the inhabited places. I procured a few specimens, as you see here: male, female, and egg.

ART. XVI.—*Observations on* Puffinus gavius (*Forst.*), *Rain-bird*, (Hakoakoa), *their Habits and Habitats.*

By A. REISCHEK, F.L.S.

[*Read before the Auckland Institute*, 21*st September*, 1885.]

THIS Puffin frequents the coast of New Zealand, especially that of the South Island, where I have seen them plentiful, but in the North it is not so common. The plumage of the whole

upper part, including wing and tail, is glossy brownish black, each feather lighter shafted, which is especially noticeable in the larger wing covers; side of the face and neck is greyish brown; throat and under-surface, white; eyes, black; feet, flesh colour, darker on the edge; webs, yellowish; upper part of the bill, blackish brown, lighter at the edges and tip.

The measurement of adult bird, from tip of bill to the end of the tail, is 14 inches. Wing, from flexor to the tips, 8·5; tail, 2·5; bill, from the gape, 1·75; tarsus, 1·5; middle toe, 2.

In December, 1880, I shot a pair of these Puffins, between Morotiri and Taranga Islands, and in the same month I found young birds on the larger Morotiri Island. In October, 1882, on the north-eastern portion of Hauturu Island, I found a female of *Puffinus gavius* sitting on an egg, and, at the same place, towards the end of November and early in December, I found young birds.

Puffinus gavius come on shore in September, to clean out their burrows or make fresh ones, which they accomplish by digging with the bill and extruding the refuse with their feet; they work during the day, and after sunset they leave for their ocean haunts, returning before sunrise. These birds breed in single pairs. The entrance of the burrow is from 4·5 inches in diameter; the distance to the chamber, from 1 foot 6 inches to 3 feet. The chamber is 1 foot 6 inches long, and about 1 foot 8 inches high; in this there is a deepening with a few leaves, on which, in October, the female lays a white egg, which is 2·35 inches in length, by 1·75. She hatches during the day, when the male is generally out at the ocean, from which he returns after sunset, when the female leaves for the haunts, returning before sunrise, continuing this process till the young birds are a few days old, when both parents absent themselves during the day, but return after sunset to feed their young with an oily substance or matter which they disgorge into their bills. The young birds are covered with darkish grey down, and are full-grown in March, when they leave the breeding resorts for the ocean. The Natives procure and use them for food. The adult bird makes a noise resembling the cackling of a fowl, especially before bad or wet weather, from which the natives name them *Hakoakoa;* and at such times, when the Natives hear this bird, they never venture out at sea in their canoes or boats.

Their enemies, besides man, are cats, dogs, and pigs. I procured a series of specimens, as you see here, for observation and examination.

Art. XVII.—*Observations on* Puffinus assimilis (*Gould*), Totorore, *their Habits and Habitats.*

By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 21st September*, 1885.]

As far as I know, this species has not been previously recorded from New Zealand, I therefore devoted extra attention to it, during my seasonal researches from 1880 until 1885, to find out if it is distinct from any of the local species. The first time I met with this Puffin was in December, 1880, on Morotiri Island, in a burrow, together with the Tuatara lizard (*Sphenodon punctatum*); the lizard I found generally in the first chamber from the entrance, and the bird in the second. I have seen adult, young birds, and eggs, together with the Tuatara lizard, in a burrow.

On my return to Auckland, in 1881, T. Cheeseman, F.L.S., and I, examined these birds carefully, and found they were dissimilar to any of the Puffins already described in New Zealand, but agreed with the description and measurements of *Puffinus assimilis* (Gould) as given by Gould in his book, "Birds of Australia." He says, "the specimens I procured were caught on Norfolk Island, where it is said to breed, consequently the seas washing the eastern shores of Australia might be considered its native habitats; it is evidently the representative of *Puffinus obscurus*, of Europe. On my homeward voyage from Australia, I saw numerous examples, flying off to the north-eastern end of New Zealand, and this, I regret to say, is all the information I have to communicate respecting it."

As I had not sufficient knowledge and material then collected by my first observation, I determined to observe them carefully, and secure a series of specimens, which you see here, and which I have obtained in the past four years.

Puffinus assimilis (Gould).—This little bird comes ashore in October to clean out its burrows, or make fresh ones, which process male and female accomplish together, with their bills and feet. The entrance is from 4 inches in diameter, and from 3 to 4 feet to the chamber, sometimes in a winding direction. In most cases I have found two chambers, similar in size to those already described, in which there is a deepening, covered with a few leaves and grass, where the female lays, end of October or early in November, one white egg, 2·1 inches long, 1·3 wide. Both parents assist in hatching and rearing the young. Their habits, during the breeding season, are similar to those of the *Procellaridæ* family, previously fully described. The young birds are full-grown in February, when the Natives collect them for food, and they are delicious eating.

I saw these birds in considerable numbers during the breeding season, on the outlying islands off the East Coast, especially on the Morotiri group. The plumage of *Puffinus assimilis* (Gould), *Totorore*, adult, is: crown of the head, upper part, wing, and tail, sooty black; side of the face, throat, and under-surface, white; eyes, blueish black; tarsus, light flesh-colour, with a blueish tinge, yellowish at the webs. The measurement from tip of the bill to end of the tail is 11 inches; wings, from flexor, 7·5; tail, 2·75; tarsus, 1·38; middle toe, 1·75. From the foregoing it is obvious that this species differs in plumage and size from *Puffinus gavius*, also the egg. Seeing *Puffinus gavius* and *P. assimilis* in the distance on the ocean, they appear alike, but the flight of *P. assimilis* is more active. Another contrast between the two species is that while the down on the very young of *P. assimilis* is light grey, the throat, breast, abdomen, white, the down of *P. gavius* is altogether grey, of a darker colour. The measurement of skeleton of adults compared, show: *Puffinus assimilis* (Gould), *Totorore*, from tip of bill to vent, 9·1; wing, the whole length, 6·85; leg, 6·5; head, 2·6. *Puffinus gavius*, from tip of bill to vent, 11·5; wing, 8·5; leg, to tip of toe, 7; head, 3·1. The Natives call *P. assimilis* "*Totorore*," and *P. gavius*, "*Hakoakoa*." Having amassed the facts which I have given you, I placed them before Professor Thomas, F.L.S., and T. Cheeseman, F.L.S., and, after a careful examination of the specimens, they agreed with me that this is *Puffinus assimilis* (Gould), a new species to New Zealand, which I have the honour to add to the Ornithology of this country, raising the number to 177; I have also to acknowledge my indebtedness to the Right Rev. Dr. Cowie, Bishop of Auckland, who kindly lent me the illustrated part, fol. 7, Gould's "Birds of Australia," where there is a life-size coloured illustration of *Puffinus assimilis*, as you see here, with a series of specimens for examination.

Art. XVIII.—*Observations on the Habits of New Zealand Birds, their Usefulness or Destructiveness to the Country.*

By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 19th October*, 1885.]

Hieracidea novæ-zealandiæ, *Lath.*—Quail Hawk (*Kaiaia*).

Male and female of this species are similar in plumage, but the latter is larger in size. They prey on wild and domestic fowl, and are very destructive. I have often seen them swoop down on and kill wild pigeons, ducks, etc.

HIERACIDEA FEROX, *Peal.*—Sparrow Hawk (*Karewarewa*).

This hawk is similar in plumage to the former, but differs in habit, and is smaller in size, the female being the larger. It inhabits the mountains, where the forest is low and dense, and I found both species on the West Coast, South Island. In November, 1882, when encamped in the centre of Hauturu Island, I often heard the cry of young hawks, which I followed on one occasion, but a precipice prevented me getting near. I then climbed a tree, and soon saw at a short distance below me, in the crown of a bushy tree, a nest with three young birds; but, though I tried to descend at several places, I was unable to get any foothold, so, to my great disappointment, had to abandon the attempt to get any closer. The old birds flew about very excitedly, sometimes past my head, and I shot the female a few days afterwards in the act of darting at a kaka. This hawk is very bold, and commits much havoc. I saw them catch fowls within three yards from me; and a Mr. Silver and the Natives told me that they lost as many as 100 fowls, ducks, and young turkeys in one season. They also prey on rats, mice, and lizards. It is gratifying that these two species of hawks are not common.

CIRCUS GOULDI, *Bonap.*—Swamp Hawk (*Kahu*).

This hawk is common everywhere, especially in the swamps and plains. It is very destructive, catching anything it can master, such as poultry, game, rats, etc., and I have been told that they even attack young lambs. They also feed on carrion and eggs, and have frequently robbed me of birds which I had shot and hid, but found on my return half devoured or removed.

ATHENE ALBIFACIES, *Grey.*—Laughing Owl (*Whekau*).

Owls are more useful than destructive; but this species I never saw in the North, or outlying islands, and in the South it is extremely rare, and preys mostly on rats.

ATHENE NOVÆ-ZEALANDIÆ, *Gml.*—Morepork (*Ruru*).

This little owl is common everywhere. In the forests it prefers deep, dark gullies, hiding during the day in hollow trees, or between the thick foliage, and in caves; but in the evening, when it comes out to seek its food, its melancholy call, "more-pork," or "*ruru*," is heard. We can forgive it for catching a bird now and then, on account of the great number of rats, mice, and insects it destroys. On returning to the house of Mr. Wilson, Northern Wairoa, one bright moonlight night in 1879, I saw a Morepork swooping down; then heard a squeak; when suddenly it flew upwards, and let something drop, repeating this action several times, ultimately remaining on the ground for a time, and then flying away. On examining the spot, I found the skin, head, legs, and tail of a rat. In April,

1880, I shot a very pretty and rare variety of this owl, near Castle Hill, Coromandel, which is now in the valuable collection of New Zealand birds of J. C. Firth, Esq., Auckland. On dissecting a series of these birds, I always found numerous remains of rats and insects in their crops.

Stringops (*Kakapo*).

These birds are not destructive, as they feed on berries, moss, and Alpine vegetation. They have disappeared from the North Island and the northern portion of the South Island, and at present only inhabit a chain of mountains on the West Coast.

Psittacidæ.—Parrots.

The four species in New Zealand are only destructive when they are too numerous. During the fire in Oxford Forest, large flocks of *Platycercus novæ-zealandiæ*, Red-fronted Parrakeet (*Kakariki*), then *Platy. auriceps* (Yellow-fronted Parrakeet), came to Christchurch, destroying the fruit of orchards. They were so numerous, I could shoot them from the Museum, where several pairs bred under the roof. On the northern portion of the North Island these birds are getting very rare, except on the outlying islets.

Platycercus alpinus.—Alpine Parrakeet.

This pretty little Parrakeet I never found near a habitation, only on the mountains near the Alps, in low thick scrub; it is a rare bird. Its food consists of berries and seed.

Nestor (*Kaka*).

There are three species in New Zealand; two of them are more useful than destructive, as they destroy numerous insects and their larvæ, which they dig out of the ground or rotten wood with their strong bills; they also feed on berries and various seeds; but *Nestor notabilis* (Kea), which fed in former times on the same food as the previous one, has become now a bird of prey, and very destructive on sheep-stations. In the Province of Otago, the station-holders give a reward for the destruction of these birds. In 1878, a gentleman sent me a few Keas, just shot, to Christchurch, remarking, in his letter, they had destroyed several of his sheep. When I examined their crops, I found that they contained wool and fat. A Kea, which I had in confinement, preferred carnivorous to vegetable food. On several occasions I saw Keas sailing above sheep, and shot them on the carcase, from which I found they had extracted pieces of flesh. My opinion is that these birds became carnivorous through being numerous when sheep were introduced, and feeding on maggots, which soon appear on carcases of sheep dying on the runs, and have thus probably acquired such a liking for the fatty matter that it has emboldened them to attack live sheep, which they pick on the back near the kidneys, and thus destroy.

This species is more active than the former two. The flight and cry of the Kea is similar to that of the European Stone Eagle (*Aquila fulva*). I saw them often at a great height, sailing about, and then swooping down to the ground, where their movements are very clumsy. These birds prefer the higher regions near the glaciers, but in the winter, during the severe snow storms, they come lower down.

Ardea.—Heron (*Matuku*).

There are seven species in New Zealand, five of which feed mostly on fish. But *Ardea pœciloptila* (Common Bittern) is very useful in destroying numerous vermin. Dissecting a series, I have found in their crops remains of rats; even as many as five in one bird.

Ocydromus.—Wood-hen (*Weka*).

There are four species in New Zealand, which are destructive to young domestic and wild birds, and their eggs; but they are useful in destroying vermin, as I have seen them often digging in the ground and rotten wood for insects. They also destroy rats, of which I have found the remains in their crops. Near Lake Brunner, a prospector had a rat and Maori hen as pets, which would come every evening at tea-time to get their share, and each one came when called by its name. Sometimes these two quarrelled over food, and at last the Maori hen gave the rat such a peck on the head that he tumbled over dead.

Porphyrio melanotus, *Temm.*—Swamp-hen (*Pokako*).

These birds are destructive to agriculturists, when too numerous. As soon as the grain makes its appearance, they pull up the young shoots and eat them; consequently the farmers in Canterbury gave a reward for their destruction.

Sterna.—Sea Swallows (*Tara*).

Five species in New Zealand, which are destructive to small fish; but *Sterna antarctica* (Common Tern) I found as far as forty miles inland, following the plough, picking up the vermin, or sitting on the fences watching for them. The two species of *Podiceps*, found on the fresh-water lakes, feed mostly on small fish and various insects; they are not destructive, or do little harm, if not too numerous, as the lakes will not become overstocked where fish are introduced.

Dysporus serrator.—Gannet (*Takapu*).

These birds are very destructive to fish, which they devour in great numbers. It is amusing to watch a colony fishing near their breeding resorts, constantly swooping down and rising—they swoop with such force at their prey that the water splashes up several feet. I have often seen them catch so large a fish that they were unable to rise, and had to let it go.

Phalacrocorax.—Shag (*Kawau*).

There are thirteen species in New Zealand, and all very destructive to fish, on which they prey, especially *Phalacrocorax novæ-hollandiæ* (Black Shag), *P. melanoleucus* (Frilled Shag), *P. brevirostris* (White-throated Shag), *P. varius* (Pied Shag), and *P. punctatus* (Spotted Shag), which I have often found in the inland bays, rivers, and lakes. They are expert divers, and very few fish escape them. On my visit at Mr. Buckland's station at Kaipara, in 1885, on which there are some very pretty fresh-water lakes of considerable size, I inquired of Mr. Drew, the manager, if they contained any fish. He told me they had put carp in, but never could see any. On the banks of one of these lakes is a breeding-place of *P. varius*. Mr. Drew kindly rowed us across to it, and we shot a number of shags. Mr. W. Phillipps sent his dog after a wounded one, but biting him he let it go; the shag then dived, and took him by the front paw, and would have drowned him had we not come to his assistance. On skinning and dissecting, I found numbers of carp in these birds: one measured ten inches. In lakes or rivers where salmon, trout, or carp are introduced some trees or branches should be put into quiet water, to form a shelter and protect the fish from the shags.

Eudyptes.—Penguin.

There are nine species in New Zealand, which all prey on fish and crustacea, but the injury they do is not much felt, as they avoid inhabited places, and are mostly to be found on the outlying islets and rocks. The sea-birds on the New Zealand coast are more useful than destructive. The Natives in former times subsisted mostly on certain species, and made large expeditions to the islands where these birds breed, taking the young and eggs of the numerous species of *Procellaridæ* (Petrel family—thirty-one in New Zealand); their feathers and down are also useful.

Laridæ.—Seagulls.

There are five species in New Zealand; most of them are useful in picking up the drift along the shore. It can be forgiven the *Larus dominicanus* if she spys now and then an egg of other birds and eats it. The usefulness of these birds should be known to agriculturists, as *Larus bulleri*, and *L. scopulinus* (Mackerel-gull) follow the plough from morning till night, picking up all vermin, and also search in the meadows with the same object. When dissecting, I found as many as forty different kinds of grubs, worms, etc., in one crop. This pretty little gull should be protected everywhere. I shall now turn to the birds which are very useful to the country besides those already mentioned above; as partially so, they ought to be protected,

except for scientific purposes. Parents and school teachers should instruct their children and pupils not to molest these useful birds during the breeding season, or to destroy their nests for the mania of collecting their eggs or young. There are the museums, where local and foreign collections are represented for instruction, free to public inspection; and if the New Zealand birds are not protected, or insectivorous birds imported, the country will suffer and the beautiful forests will only resound with the humming of insects, instead of the melodious songs of the feathered inhabitants. Already several species have disappeared from the mainland, especially on the northern portion of the North Island, or are extremely rare, such as *Pogonornis cincta*, Stich-bird (*Tiora*); *Anthornis melanura*, Bell-bird (*Korimako*); *Orthonyx albicilla*, White-head (*Popokatea*); *Petroica longipes*, Wood-robin (*Totowai*); *Petroica* (*Toitoi*); Pied Tit (*Meromero*); *Creadion carunculatus*, Saddle-back (*Tieke*); *Turnagra hectori*, North Island Thrush (*Piopio*); *Stringops* (*Kakapo*); *Coturnix novæ-zealandiæ*, Quail; *Athene albifacies*, Laughing Owl (*Whekau*).

Halcyon vagans.—Kingfisher (*Kotare*).

This bird is very useful in destroying insects. It is very interesting to watch this bird in the breeding season, when boring its holes in rotten trees, which is accomplished with the bill, sitting on an opposite tree and darting at the place where it is intent on boring a hole, splint by splint, till he gets tired, when his mate begins to work. I saw them sometimes striking at a tree with such force that they got stuck, and had to twist about to extricate the bill. Near the nest they are very spiteful; anything passing the tree they dart at, and, owing to this habit, they sometimes kill young ducks or chickens if their nests are near a farm-house. I saw even dogs and cats with an eye destroyed by the Kingfisher's dart. I found their nests often several miles inland, away from any creeks or rivers, but during the winter they inhabit the seashore.

Meliphacidæ.—Honey-eaters.

There are three species in New Zealand. Every old settler will remember the clear notes of the Bell-bird (*Anthornis melanura*), or the mocking of the Tui (*Prosthemadera novæ-zealandiæ*). These birds are very useful, as they destroy numbers of insects during the breeding season.

Xenicus.—Wren, two species.

These birds, which are becoming very rare, live entirely on insects; also *Acanthisitta*, Rifleman (*Titipounamu*), which I saw from early morning until late at night, climbing up and down trees and branches investigating every crevice for insects.

ORTHONYX.—New Zealand Canary, two species (*Popokatea*).

These birds live mostly on insectivorous food.

SPHENŒACUS.—Swamp-bird, two species (*Kotata*).

When passing a swamp one will often hear a peculiar whistle, and very soon these inquisitive birds come so near, that it could be sometimes caught with the hand, were it not so cunning in secreting itself in the rushes. They live mostly on insects.

GERYGONE.—Warbler, three species (*Riroriro*).

They are insectivorous birds, their thrilling notes and artistic nest are well known.

PETROICA.—New Zealand Robin.

The five species of *Petroica* (New Zealand Robins) live entirely on insects; they are very tame birds. I had them several times sitting on the barrel of my gun when watching other birds, or picking up insects at my feet when digging, or chopping wood. The song is very melodious, especially that of *Petroica longipes* (North Island Wood Robin).

ANTHUS NOVÆ-ZEALANDIÆ.—Ground Lark (*Pihoihoi*).

This bird lives mostly on insects, also the two species of *Turnagra* (Thrush), which are getting very rare.

RHIPIDURA.—Fantail (*Piwakawaka*).

Everyone admires the two species of these fly-catchers, and their graceful evolutions in catching their prey, in the act of which, a snap of the bill can be distinctly heard. On the West Coast Sounds, where the sandflies are in myriads, I saw in the little clearing near the hut as many as twenty of these fly-catchers in pursuit of sandflies, from early morn till late at night.

GLAUCOPIS.—Crow, two species (*Kokako*).

These birds feed mostly on berries and young leaves; their notes are very melodious, similar to those of a flute. In the pairing season, the movements of the male are most amusing, with spread wings and tail, and outstretched neck, performing most extraordinary evolutions similar to dancing.

CREADION.—Saddleback, two species (*Tieke*).

They are very useful in destroying insects, picking them out of rotten wood and between the bark, similar to the Woodpecker; they also suck honey out of the blossoms.

HETERALOCHA.—Huia.

These are also insectivorous.

CUCULIDÆ.—Two species.

They lay their eggs in the nests of the Robins or Warblers, which have to collect insects from early morn till late at night to

appease the hunger of their foster offspring. These Cuckoos live entirely on insects.

CARPOPHAGA NOVÆ-ZEALANDIÆ.—Wood Pigeon (*Kuku*).

This pretty bird is getting scarcer every year, and is esteemed for its delicious flesh; it feeds on berries and young leaves.

APTERYX.—Kiwi.

The four species, which are getting very rare, especially *Apteryx australis* and *A. haastii*, as they have no defence against their numerous enemies, except by running and hiding in burrows. Their food consists of various insects and berries.

THE WADERS.

All the Waders—such as *Charadriadæ*, *Hæmatopi*, *Limicola*, *Tringa*, *Gallinago*, etc., which form a numerous family, there being twenty-two species in New Zealand—are esteemed for food when in season. Their food consists of *Crustacea* and *Mollusca*.

RALLIDÆ.—Land-rails, five species.

ANATIDÆ.—Ducks, nine species.

These are all useful for their flesh, down, and feathers. Their food consists of different plants, seeds, grass, growing in the water or on the edges; also of insects and vermin of all kinds which they can overpower.

If the insectivorous birds are not protected, the result will be disastrous, as I have seen on several occasions during my travels. On a first visit to a certain district everything looked nice and green, but on visiting six weeks later the same place, I was astonished to see only patches of sward here and there, and thousands of caterpillars, which destroyed the vegetation. In another place, besides the destruction of vegetation, the paper and paint on the walls in the house, even blankets and clothes, were gnawed by crickets. The numerous dogs, and even cats, of itinerant travellers and Natives, let at large, (the poor brutes often being obliged to procure their own subsistence, and sometimes being abandoned,) become wild, and prey on birds; but if stoats, ferrets, weasels, mongoose, and cats are turned out to destroy rabbits, it will be difficult to protect the birds, as these creatures destroy them, especially ground birds, such as kiwis, kakapos, wrens; and many other of these interesting birds peculiar to New Zealand must disappear, even from the solitudes. It should be remembered that some of these animals prefer their abode near a habitation, where they make much havoc amongst poultry, as they just kill as many as they can get hold of, without eating them. In the Old Country, I remember as many as over twenty fowls in one night were destroyed, and the eggs taken away from the brood hens, which were killed first; and in Austria we destroy these animals at every opportunity. They are very cunning,

and will not take poison while they can get live prey. Rabbits are much easier destroyed by shooting, netting, or bagging with ferrets, when the land becomes more closely settled. I feel sorry that in this colony there is not more interest taken in nature and its resources; I do not mean that people should follow it as a pursuit, but more as a recreation, in leisure time. Through the extermination of forests, birds are forced to disappear; and it is a waste of timber, where the soil is too poor for agriculture and pasture, to burn and destroy the young trees for the purpose of getting a few large ones, or kauri gum, all of which might be secured without this wanton destruction, and thus save the bush and its useful inhabitants, of which we could learn a great deal by observation.

Looking at the building of nests, how artistically some are made, as that of the *Gerygone* (Warblers), through which rain cannot penetrate! When building, the male of most birds carries the material, and the female builds the nest; and if not contented they pull it to pieces, and begin afresh. In hatching they assist each other, and as soon as the young are out of the eggs, the parents show great pleasure and anxiety. From sunrise to sunset they collect insects to feed their brood, and they destroy a vast number in a single day. Then, their language: each sound has a different meaning. When the young in the nest chirp, hearing the warning sound from their parents, they are immediately quiet; and when out of the nest, at the approach of danger, the old birds hide their young, which remain quiet and still till the parents decoy their enemies away. I noticed this to be often the case with *Anthornis* (Bell-bird). When the young are able to feed, the parents show them how to procure food. Birds of prey take their young, and teach them various evolutions in the air, how to swoop on their prey, and make them very precautious against enemies. I saw old birds often punishing their young, if they did not listen to their call. Insectivorous birds show their young how to procure insects, by investigating every crevice, turning over refuse on the ground to procure grubs, or picking them out of rotten wood. As soon as the young are old enough, they have to look out for themselves. They all have to work for their existence, and are not selfish. I saw, often, over a hundred birds, of four or five different species, feeding together, and very seldom noticed one deprive another of its food. In conclusion, I should respectfully urge the necessity of effort to preserve the useful birds of New Zealand, which are of so much importance to the colony; and if this paper is the means of inducing anyone to interest himself in that direction, I shall be well pleased.

Art. XIX.—*Notes on the Habits of some New Zealand Birds.* By A. Reischek, F.L.S.; communicated by Professor Parker.

[Read before the Otago Institute, 11th August, 1885.]

Ocydromus fuscus, *Dubus.*—Black Wood-hen (*Weka*).

I observed this bird during my stay at the West Coast Sounds, in 1884. I saw them mostly at dusk, roaming about stony river beds, seeking food; the numerous dead trees, which are swept down along the banks by floods, affording them hiding places. I have also seen them on the seashore, picking up mussels, crabs, &c., and on the mountains, as high as 3,000 feet above sea-level, but scarce. During the day, they conceal themselves under roots and in hollow trees, their hiding places having generally two or three entrances, so that in case of disturbance they can easily escape. I was amused once at seeing my dog digging vigilantly at a burrow, while the wood-hen was quietly stealing away. On the dog pursuing her, she dodged him in the coolest manner for nearly a quarter of an hour, by going under the trees, and always taking care to keep on the opposite side from that on which he was; but on my coming to the dog's assistance, she gave a shrill whistle, and ran quickly away. When undisturbed, these birds are very bold and tame.

I always make it a rule not to shoot or molest birds near my camp, so as to observe them, and listen to their sweet songs. At Dusky Sound, a shining black wood-hen came every morning and evening to my camp in the gorge, uttering a shrill whistle of one note, and, on my throwing her a piece of biscuit, she would pick it up, throwing it on the ground till it broke, and then eat it. She became so tame that she would walk round the dog, and come into the tent; and on a second visit to this camp, I found she still haunted the place. On the 25th April, at daylight, I was awakened by a noise, and, on looking up, saw one of these birds amusing itself with my slippers, but on my moving she retired. On the 21st August, early in the morning, I shot a specimen, which never moved when picked up. I tied a string round its legs, and hung it up, intending to skin it after breakfast; but on going to do so, to my astonishment the bird had disappeared. I sent the dog to find it, but he could not. On the 24th, I let the dog loose for a run. He went into the bush, and returned with a live wood-hen, which I found on skinning so riddled with shot, that I thought it wonderful it could have survived. On the 27th, I went late in the evening along the left side of the Sound to observe nocturnal birds. About fifty yards from shore, I saw a bird swimming, which I shot at, and my dog immediately

swam after, but on his approach it dived rapidly, coming always nearer the land, the dog being so close that I could not fire again. The bird managed to get ashore, and ran swiftly into the bush, the dog following; but in a short time he returned with a black wood-hen, which, on skinning next morning, I saw had a number of shot in the neck and body. I was surprised at these birds being such expert swimmers and divers. Sometimes they followed me long distances to the camp, and carried everything they could manage, such as spoons, knives, candles, etc., away, if I forgot to secure everything well. In September, during a severe thunder and snow storm, one of the black wood-hens actually came into the hut where I was working, to take shelter, and it stayed a considerable time.

The breeding season, Mr. Docherty told me, is in January, when they lay from two to three eggs. I saw in April two females, with three young birds each, fully feathered. They were duller in plumage and smaller in size than the parents. Male and female do not differ in plumage, but there is a slight difference in size, the latter being smaller. These birds vary much in plumage, but jet-black ones are rare. They come out from their hiding places in the evening, or on dull days, when one can hear their melancholy whistle, consisting of three notes, "*u*, *o*, *e*," especially before bad weather. Their movements are very quiet. They scratch with their legs, and pick with their bill in rotten wood or earth for insects, in a similar manner to the domestic fowls. They also prey on rats, young birds and their eggs, then lizards, fish, crustacea, and berries. These, with shells and small stones for digestion, I have found in their crops. I never saw these birds using their wings. When skinned they make delicious broth, also their meat is good to eat. I procured specimens.

Glaucopis cinerea, *Gml.*—Orange-wattled Crow (*Kokako*).

This species represents, in the South Island, the *Glaucopis wilsoni* of the North; but the plumage is a little lighter, a light slate color; and one-half of the wattle orange, the other, dark blue. The wattles of the young birds are smaller and much lighter. This bird haunts open places with low scrub. When I was on the West Coast, South Island, in 1877, I saw this bird on Arthur's Pass, about 3,000 feet above the sea-level, sitting on a stone a few feet in front of me. In January, 1878, on Mount Alexander, about 2,000 feet above the sea-level, I met it everywhere, hopping very swiftly amongst low scrub and stones. I also found it on the ranges on the left bank of the Teremakau River, but not so frequently, as they have a preference for certain localities. The shepherds have told me that these birds only come down to the lowlands during severe winters.

During my research in 1884, at the West Coast, South Island, I did not find these birds so plentiful. I saw them here near the sea shore, also up on the high ranges, especially on the outskirts of the forests, roaming about in pairs, ♂ and ♀, or with their brood, generally three in number. They are very tame, but, when disturbed, are adepts in the art of hiding, either under a limb in the fork of a tree, or between thick leaves. On one occasion, I observed a pair of these birds at Dusky Sound. One I shot; and, not noticing the other go away, I waited, and presently saw its head peeping out from behind the limb of a tree, then drawing it back; and, repeating this action several times, it eventually hopped out on the branch, looked about, and, noticing me, went away very quickly. The movements of this bird are exceedingly quick; but, from the construction of the wings, it is not able to fly far, and that only when in extremities. Male and female are inseparable; the male utters a very sweet whistle, consisting of six notes, as "*te, to, ta, tu, tu, tu*"; the call of the female is composed of five, as "*te, a, tu, tu, tu.*" At a distance it very much resembles the sound of the flute. At Milford Sound, in October, 1884, I shot a crow, and then concealed myself until its mate appeared, which it did in a very short time; and, to my astonishment, instead of flying away when it saw me, the poor thing went to its dead companion, hopping around and calling, evidently in a great state of agitation. I felt so much for this bird, that I was very sorry I had shot its mate, and let it go. The pairing season begins in October, when the male makes extraordinary evolutions before the female, similar to the European Wood Grouse (*Tetrao urogallus*). He bows his head about, spreads his wings, and erects and spreads his tail, making at the same time a gurgling noise. They build their nests in thick scrub, not far from the ground, of twigs and moss. In the beginning of December the female lays from two to three eggs. Mr. Docherty and Mr. Sutherland told me that they have found their eggs in December and January. The young birds are full-grown in May, but they remain with their parents until the pairing season. The scarcity of these birds near habitations is due to their confidence, through which they often fall a prey to cats and men, which are their worst enemies. They are rather dry for eating. Their food consists of berries and young leaves, which I have found in their crops. I procured specimens.

Art. XX.—*Observations on* Sphenodon punctatum, *Fringe-back Lizard* (*Tuatara*).

By A. Reischek, F.L.S.

[*Read before the Auckland Institute*, 21*st September*, 1885.]

On this remarkable lizard I have already written and forwarded a paper to Dr. Julius von Haast, F.R.S., etc., which he read before the Philosophical Institute, Christchurch. (See "Trans. N.Z. Inst.," vol. xiv., 1881.) Since then I have had many further opportunities of observing them on various islands off the coast of New Zealand.

On the Morotiri Islands, I found them common, in burrows by themselves, but oftener with the *Procellaridæ*. On my first visit to Taranga Island, in 1880, I searched the southern and western portions without seeing a single specimen; and I also searched Hauturu Island in the same year, with a similar result. On my second visit to Taranga Island, when searching the rest of that island, at the north-eastern portion, my dog set at a small burrow, and on examining it, I found a fine specimen of *Tuatara*. Afterwards, at the same place, I examined a number of burrows, so small that *Procellaridæ* could not enter. Some had a small chamber, others none; but I never found more that one lizard in each. The entrance measured from 3 inches in diameter, the burrow from 2 feet to 4 feet long. The *Tuataras* must have excavated these burrows, as they were different in form from those in which the birds are found associated with them. These lizards vary in colour from those on the Morotiri Islands, being a more greenish grey, with light spots, as I have a similar specimen here for examination. I think Dr. W. Buller, F.R.S., described it as *Ginteri*. I long since maintained that these lizards burrow, when others expressed doubts about it; but during five years' observation, I found many proofs, which have fully confirmed my first description; even in confinement, in my possession, they burrow; and Professor Thomas has a number for observation, which burrow even in stiff clay.

A remarkable fact in connection with these lizards is, that on all the larger islands they live principally on insectivorous food, such as beetles, grubs, wetas, grasshoppers, flies, etc., which I found on dissecting. They are thus very useful in destroying these vermin, and it is a pity that they are extinct on the mainland. A. Grainger, Esq., had a *Tuatara* nearly a year in his garden, which made her abode under the aviary, coming out at night in search of food. I never found any remains of birds, on dissecting *Tuataras* on the larger islands, living in the same burrow with *Procellaridæ* and their eggs. I think where

insectivorous food is plentiful, which they prefer even in confinement, they will not prey on birds.

On my visit to Karewa Island, at the beginning of this year, with Professors Parker and Thomas, I saw many young birds with their heads off. Professor Thomas got one of these lizards with a bird in its mouth, and I followed one which had a bird of considerable size in its mouth; it tried to escape in a burrow, but got stuck at the entrance. They catch the bird by its head, and then chew until it is devoured. My opinion is that, as this island is so small, and these lizards so numerous, this is the reason they prey upon birds. They live there along with *Puffinus brevicaudus*, on which, though it is a digression, you will allow me to make a few remarks. This species of Puffin is numerous on Karewa during the breeding season. In the daytime only single specimens, and their young, remain on the island, but in the evening we saw flocks of thousands of these birds circling round the camp. They seemed rather surprised to find a solitary habitation occupied. After sunset they settled on the ground, in some places so thickly that one could hardly walk without treading on them; instead of going out of the way, they defended themselves by biting, they even came into our tent, and we were obliged to throw them out and shut it up; then they burrowed in underneath. When preparing tea, one gentleman had to watch and keep them off the fire, and, when frying fish, they actually walked through the frying-pan. The variety of their vocal powers was most amusing, and when they joined in chorus it was deafening. One night I went into the bush with a light for the purpose of observation: a whole flock of these birds flew at me and knocked the light out of my hand; I did not allow my dog to touch them; they went on his back, walked over him, and sat alongside of him. These birds are very vicious when molested. Leaving Karewa and coming back to Hauturu Island, on my second and seasonal researches, I examined the whole island; on the eastern part I found a few *Tuataras*, but they are very rare. These lizards differ from the common *Tuatara*, in colour, form, scales, and touch of the skin.

The colour of the common *Tuatara* (*Sphenodon punctatum*) is: top of head, upper part, and sides, from dark to greenish grey, spotted with greyish white; throat, slate grey; abdomen, greyish white; the claws are tinged with yellowish green. The crest on the nape and back is very prominent, the spines are softer and flat in form, the scales and skin are coarse to the touch. The size is according to the age, from 8 inches to 2 feet long; the head 2·5 inches in length, 1·25 in width; the front leg, 3·5 to the tip of toe; hind leg, 4·5. The brick-red variety, which I found on Hauturu Island: colour, top of the head, back, and sides, light brick-red with brown bars; an elongated brown band on each side of the neck; and over the chest, throat, sides of the face,

light grey, with seven rows of light dots; abdomen, fawn colour; a yellowish green ring round the eyes. The crest on the nape and back is small, the spines are small and round, the scales on the skin fine and soft to the touch. Measurement of adult: 1 foot 5 inches, total length; length of head, 2·5; width, 1 inch; front leg to the tip of toe, 3 inches; hind leg the same. It may be that this variety does not deserve to be ranked as a distinct species from the common *Tuatara*, but at the same time I think it a very well-marked local form, which has probably arisen during long isolation on Hauturu Island. In many respects this variety seems most distinct from the common *Tuatara*, the crest both on the nape and the back are much finer, the separate spines are round, not gently flattened as on the common species. The form of the head is more of an oval shape, the scales, including those at the sides of the body, are smaller, and softer to the touch, the colour markings are decidedly different from the common *Tuatara*. The difference in colour might be due to the lighter character of the soil on which they live, as I have often found with animals and birds.

Here I have a series of specimens for observation, which Professor Thomas, F.L.S., T. Cheeseman, F.L.S., and I, have examined carefully. These gentlemen agree with me in the general tenor of these remarks.

Art. XXI.—*Notes on the Habits of the Polecat, Ferret, Mongoose, Stoat, and Weasel.* By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 30th November,* 1885.]

Putorius putorius.—Polecat.

This animal is common in Europe, except North Russia and Lapland, and is found in Siberia, Kamtschatka, and Tartary. It frequents mountains, forests, plains, and settlements; and makes a comfortable nest of grass, moss, leaves, &c., in hollow trees, or under the roots; between rocks, thick scrub, or in burrows, which they excavate if unable to find any already available. In severe winters they come near settlements, where they take up their abode in hay or straw stacks, stone walls, or some unmolested places about farm-houses, where they make great havoc amongst the poultry and eggs; and in Austria a reward is offered for their destruction. They destroy all the small animals and birds which they are able to overpower, and are even dangerous to children.

At a place in Austria where they are numerous, on one occasion when I was out hunting, I disturbed a hiding-place of these animals amongst the rocks, from which four came out,

and, instead of attempting to escape, they defended themselves in a most plucky and aggressive manner, by biting at my boots and stick, until I had destroyed the last. Their movements are active, and they are good climbers, swimmers, and divers. The female, after a period of two months, brings forth from three to six young, which are full-grown in about four months.

PUTORIUS FURO.—Ferret.

These animals belong to the same class as the former, but are smaller in size and more delicate in organisation, and cannot stand cold climates. They were reared in confinement in ancient times, and are mentioned by Pliny. They are now used for destroying rabbits and rats; but they are almost as destructive as their ally the polecat to small animals, birds and their eggs. They increase rapidly, having from four to eight young at a time.

HERPESTES ICHNEUMON.—Mongoose (Pharoahan Rat).

These animals are useful in destroying snakes and vermin, but are very destructive to domestic and wild birds and their eggs, besides killing animals much larger than themselves through their cunning and activity. They destroy more than they eat, in most cases merely sucking the blood and devouring the brain. The Arabs and Egyptians hunt and destroy them at every opportunity. They are common in Africa, Egypt, and Barbary, inhabiting the lowlands, and generally near rivers, where they conceal themselves in burrows or thick undergrowth, from which they watch for their prey. There are several varieties and species belonging to this genus, whose habits are similar to the species already described.

MUSTELA ERMINEA.—Stoat, or Large Weasel.

This animal when full grown is about 14 inches in length, with a very slender body and short legs. The colour in summer is a reddish brown; throat, under-part, and inside the legs, white. In winter it changes to white, except the black brush on the tail. I have shot, on several occasions, piebald and spotted ones. They are very active, day and night; are expert in climbing, swimming, and even diving. Pursuing their prey stealthily, they make a final spring to secure it. I do not know any animal pluckier or more vicious than these: they attack and overpower animals three times their own size. If one cannot master its prey, on its making a hissing noise others come to its assistance to conquer the victim, biting at its throat till it succumbs. They even attack children, if they interfere with them. They are useful in destroying rats and mice, but do great harm amongst poultry, small animals, birds and their eggs. I know cases where they killed every fowl about the house, and pigeon in the cots, in one night.

These animals inhabit plains, mountains, and forests, hiding in burrows or under stones or in thick hedges; and I also found them in farm-houses, where they had a dry place of concealment, and where they make a nest of grass and moss to sleep.

In the month of June, in Austria, the female brings forth after five weeks from four to eight young, which she protects with great bravery. The family stay together till the winter.

Mustela vulgaris.—Common Weasel.

This pretty little animal has the same habits and habitats as its ally the stoat, and is not behind it in bloodthirstiness. If the larger carnivorous animals were as courageous and vicious as these, they would soon reduce materially the limits of animal life.

Art. XXII.—*The Protection of Native Birds.*

By Hugh Martin.

[*Read before the Nelson Philosophical Society, 2nd March,* 1885.]

Birds peculiar to New Zealand that should be preserved in island reserves:—

A.—Birds inhabiting the Mainland.

4. *Athene albifacies.*—Whekau, Laughing Owl. South Island, and Kaimanawa Range in North Island.

9. *Pogonornis cincta.*—Hihi, Matakiore, Stitchbird. North Island.

10. *Prosthemadera novæ-zealandiæ.*—Tui. Both Islands; also, Auckland and Chatham Islands.

11. *Anthornis melanura.*—Korimako. Both Islands, and Auckland Islands. Rare in many parts.

32. *Turnagra crassirostris.*—Piopio, Southern Thrush. South Island. Now rare, and in many parts extinct.

33. *T. hectori.*—Piopio, Northern Thrush. Southern part of North Island.

37. *Glaucopis wilsoni.*—Kokako, Blue-wattled Crow. North Island. Very irregular in distribution.

38. *G. cinerea.*—Kokako, Orange-wattled Crow. South Island. Very irregular in distribution.

40. *Creadion carunculatus.*—Tieke, Saddle-back. Both Islands. Flight feeble.

41. *Heteralocha acutirostris.*—Huia. South part of North Island, in Ruahine, Tararua, and Rimutaka Ranges.

42. *Stringops habroptilus.*—Kakapo. Both Islands and Chatham Islands. Incapable of flight. Very rare.

47. *Nestor meridionalis.*—Common Kaka. Both Islands.

49. *Nestor notabilis.*—Kea. South Island, in Alpine regions.

52. *Carpophaga novæ-zealandiæ.* — Kereru, Kuku, Pigeon. Both Islands, and Chatham Islands.

54. *Apteryx mantelli.*—Northern Kiwi.

56. *A. oweni.*—Grey Kiwi. Both Islands.

55. *A. australis.*—Southern Kiwi.

57. *A. haasti.*—Roaroa, Kiwi, Karuai. South Island, in Alpine regions.

85. *Ocydromus earli.*—Weka, Northern Wood-hen.

86. *O. australis.*—Weka, Southern Wood-hen.

87. *O. fuscus.*—Black Weka. West Coast of South Island.

88. *O. brachypterus.*—South Island.

93. *Ortygometra affinis.*—Koitareke, Water Crake. Both Islands. Extremely rare everywhere.

95. *Notornis mantelli.* — Takahe; Moho. Resolution and Secretary Islands; and at Barepatch, between Maruia and Upokororo Rivers, east of Lake Te Anau.

98. *Casarca variegata.*—Putangitangi, Paradise Duck. Both Islands.

100. *Anas chlorotis.*—Pateke, Brown Duck. Both Islands and Chatham Islands. A very indifferent flier.

102. *Rhynchaspis variegata.*—Kuruwhengi, Shoveller. Both Islands and Chatham Islands. Nowhere common.

103. *Hymenolaimus malacorhynchus.* — Whio, Blue Duck. Both Islands.

104. *Fuligula novæ-zealandiæ.*—Papango, Scaup, Black Teal. Both Islands. Flight very feeble.

108. *Podiceps rufipectus.* — Totokipio, Dabchick. Both Islands.

B.—BIRDS PECULIAR TO THE OFF ISLANDS.

12. *Anthornis melanocephala.*—Korimako. Chatham Islands.

83. *Gallinago aucklandica.*—Snipe. Auckland Islands.

89. *Cabalus (Rallus) modestus.*—Mangere Islands, Chatham Islands.

91. *Rallus dieffenbachii.*—Moeriki. Chatham Islands. Extremely rare, if not extinct. Perhaps identical with No. 89.

92. *Rallus brachipus.*—Auckland Islands.

106. *Mergus australis.*—Merganser. Auckland Islands. The only known Merganser in the Southern Hemisphere.

Cnemiornis calcitrans.—Tarepo. (Kaimanawa Range ?)

A large bird is mentioned in the Transactions of the N. Z. Institute by, I believe, Mr. T. Cockburn Hood, as having been killed by a settler's dogs; which bird, if I remember rightly, was supposed by the writer to be a Tarepo.

The birds that most need preservation may be included under the following heads :—

1. Rare birds, and those that are decreasing rapidly: *e.g.*, No. 4, Whekau; 32-3, Thrushes; 42, Kakapo; 54-7, Kiwis; 93, Water Crake; 95, Takahe; 102, Shoveller Duck.

2. Birds of local habitat, and those of irregular distribution: *e.g.*, Nos. 37–8, Kokako; 41, Huia; and those peculiar to the Auckland and Chatham Islands.

3. Birds that are incapable of flight, or whose flight is feeble: *e.g.*, No. 40, Saddle-back; 85–8, Weka; 100, Brown Duck; 104, Scaup.

As may be seen, these divisions run into one another, and include almost all the peculiar species enumerated here.

I have included the Kea, as I think it would be possible to preserve it in certain islands, such as the Aucklands, where it would be harmless, and useful to man. The Kaka, Pigeon, Paradise Duck, Brown Duck, Shoveller, Blue Duck, and Scaup, being peculiar to New Zealand, and also valuable game birds, merit preservation, even though abundant.

The thirty-six peculiar species of birds named in the above list are, of those enumerated in the "Handbook of the Birds of New Zealand, 1882," all that I believe it to be at once practicable and desirable to preserve in island reserves. I should have omitted the birds peculiar to the Auckland Islands, as being, from the nature of their habitat, in no danger of extinction, had I been certain that these islands are uninhabited, or likely to remain so. I omit the native Quail, as being probably extinct; but even if it still survives, the time and money that might be spent on it would be better employed in procuring specimens of the Takahe and other peculiarly New Zealand forms.

On the necessity of immediate and effectual measures for the preservation of all rare ground-birds, such as the Kiwis and Kakapo, I needly hardly remark; but two species, the Takahe (*Notornis*), and Tarepo (*Cnemiornis*), deserve particular notice. The Takahe measures 25 inches in length, the Tarepo, at least 5 feet in height; so that they are well worth preserving from any point of view. Generally speaking, experience proves that no one will refrain from killing any rare or strange bird, unless it can be made more to their interest to do so. As, with very few exceptions, rare birds, such as these, are always killed by the bird-hunters, miners, and others living in the back country, who alone have opportunities to obtain them, I would submit the following (especially to prevent their destruction), as being the only effectual means for obtaining live specimens of these and other rare birds:—a premium should be offered, in addition to whatever other means may be employed, for all specimens that can be procured of the rarer birds, especially of the wingless ones, payable only on the reception of the birds *alive and*

in good condition; the highest sum being offered for the largest species of birds. The same should also be offered for the discovery of new species, in order to save them from extinction. I suggest this in the belief that, if acted on without delay, it will ensure the preservation of various birds that otherwise will be lost; and particularly that, besides being in the end the cheapest as well as the most effectual way to procure the rarer species, (being made known to all throughout those parts where such birds do or may exist,) it is the only way to save the Takahe and other large birds, which would in every way be well worth all it might cost to preserve them. As there must be some delay in establishing reserves, it would perhaps be well for immediate measures to be taken to procure rare "wingless" birds, (lest when the reserves are ready it may be too late to procure them,) keeping them in confinement, under as natural conditions as possible. By the time the birds have been obtained the reserves should be ready for them. Very rare birds, such as the Takahe, should, however, be kept under special supervision (in islands), at least until they become abundant.

In regard to the nature of bird reserves, there can be no doubt but that islands isolated by the sea are most suitable for that purpose, as will appear from a consideration of the following points: The objects to be gained being the preservation *and increase* of curious and useful birds, to obtain this result it is obvious that they should be as much as is possible protected against the ravages of beasts of prey.

The beasts to which the destruction of the indigenous birds is chiefly due, are the rat, cat, dog, and pig, to which must now be added the ferret, stoat, weasel, and mongoose; and were it not for their ravages, it is not improbable that many birds now rare would be comparatively abundant, and that very few would be in imminent danger of extinction. As it is, any scheme for the preservation of native birds must provide against their intrusion into the bird reserves.

Granting that it is possible to effectually fence out dogs and pigs, there yet remain other beasts that are even more destructive, and which it is practically impossible to keep out by any artificial barriers. The rat, it is true, is everywhere, but, as I have elsewhere observed, it would be kept under in island reserves by the owls and wekas, there being only the natural increase to contend against, the water being an effectual barrier against the ingress of more, save by the agency of man; whereas on the mainland there can be no such protection. Similarly, the water would bar the ingress of cats, weasels, and ichneumons, which could not be done otherwise, except at the expenditure of very much time and money. Islands, on the other hand, have in their favour both economy and efficiency,

such as cannot be attained otherwise, besides the saving of time, which is of great importance. In regard to Resolution and Secretary Islands, there are three possible faults in them, which would impair or nullify their value for reserves: 1st, their roughness and size may preclude the exercise of due supervision over them; 2nd, their shores may be too close to that of the mainland, so that they may not have a sufficient breadth of water to keep out noxious beasts; 3rd, pigs, dogs, or cats may have run wild in them. This seems the strongest objection that could be raised, and would be conclusive against the choice of them for reserves; but the two former might be overcome. Apart from this last objection, these islands are peculiarly suitable for birds, such as pigeons, kakas, ducks, and particularly kiwis, that require a wide range. I have omitted certain sea-fowl from the foregoing list, as they would be better protected throughout New Zealand against all excessive and wanton destruction, particularly in the breeding places. The birds referred to are the Penguins, Puffins (*Shearwaters*), Gannet, and some species of Petrel.

Protection for these birds is desirable, because, like the Fulmar, Guillemot, and other sea-birds of the British Islands, they are of value for their flesh, skins, feathers, and eggs. The Penguins, some of which are peculiar to Campbell and Macquarie Islands, may be taken as the southern representatives of the Auks, one species (167, *Aptenodytes pennantii*), being comparable in size to the Great Auk (*Alca impennis*), which was formerly extremely abundant in the North Atlantic, but is now believed to be extinct, having been extirpated for the sake of its flesh and eggs.

I have not disregarded the possible change involved in the removal of birds from the mainland to islands, having indicated in a previous paper several points bearing on this question. These, however, may all be said to be reducible to one, that of the vegetation; and if this is in character and luxuriance like that of the parts from whence the birds are taken, there would probably be no further difficulty.

The presence or absence of various birds, named in this list, would be a good test of their fitness for this purpose. I may mention some reasons for preserving indigenous birds, to show that this is not a question of sentiment only. They are as follows:—

First, the preservation of the birds under conditions that will enable their habits to be studied, as could not otherwise be done.

Second, the increase of rare birds, so as to enable museums, etc., that could not otherwise obtain them, to be supplied with specimens. This use of reserves would have to be guarded with extreme care to prevent any abuse of it, lest any birds should be unduly reduced in numbers or exterminated thereby.

Third, the preservation of birds that are useful as game, or capable of domestication, particularly such as the Takahe, which

are extremely rare, and must without it become extinct. Many native birds, though but little regarded here, would be valued in other countries, having much more to recommend them than sundry English ones that have been introduced. It will, of course, be necessary to take precautions against trespassing and poaching, the worst poachers being the professional bird-collectors, (who are doing their best at present to exterminate the Kiwi,) sealers, and whalers. All birds being strictly preserved, except where over-abundant or otherwise detrimental to the increase of those which it is especially desired to preserve, the reserves would serve as refuges to many sea and shore birds, as well as to Herons and other birds of wide range.

Although, strictly speaking, beyond the scope of this paper, it will not, I hope, be deemed altogether out of place to say a few words on behalf of the Tuatara. This curious and unique lizard is quite extinct on the mainland, only surviving in certain islands, and being a rare and singular lizard it is well worth preserving.

Although reiterating previous remarks, I would again call attention to the necessity of immediate action, on account of the opening up of the back country, the rapid increase of population, and last, but by no means least, the introduction of the weazel and other vermin, which must on the mainland certainly lead to the destruction of all ground-birds, and probably waterfowl also, as these nest in places easily accessible to them.

The supplementary list includes certain birds which, for reasons before stated, are well worth preserving in reserves; but not being peculiar to New Zealand, are, therefore, of less importance :—

Supplementary List.

Birds not peculiar to New Zealand.

90. *Rallus philippensis.*—Mohopereru, Striped Rail. Both Islands; Australia, Polynesia, Celebes, and Philippines.

94. *Ortygometra tabuensis.*—Putoto, Swamp Crake. Both Islands; Australia, Tasmania, Polynesia. Sparingly dispersed throughout New Zealand.

96. *Porphyrio melanotus.*—Pukeko. Both Islands; Chatham Islands, Australia, Tasmania, New Caledonia.

99. *Querquedula gibberifrons.*—Tete, Little Teal. Both Islands; Australia, New Caledonia, Indian Archipelago.

101. *Anas superciliosa.*—Parera, Grey Duck. Both Islands; Chatham Islands; Australia, Tasmania, and Polynesia.

105. *Myroca australis.*—Karakahia, White-winged (white-eyed?) Duck. Both Islands; Australia.

107. *Podiceps cristatus.*—Crested Grebe. South Island; Australia, S. Africa, Asia, North America, Europe.

Art. XXIII.—*Notes on the Bones of a Species of* Sphenodon, (S. diversum, *Col.*,) *apparently distinct from the Species already known.* By William Colenso, F.L.S., etc.

[*Read before the Hawke's Bay Philosophical Institute, 14th December*, 1885.]

Towards the end of November, 1885, I received a small parcel of little bones from Mr. Mills, of the wood and coal depôt in this town. It was brought to me by one of his workmen, who said, "they were that morning found in the quarry, while digging, at about forty-five feet below the surface." I was not very well at the time, but on looking at them, I soon saw they had belonged to some small reptile. They were in most excellent preservation, even to their minutest parts and finest processes, and were not fossilized; but, most unfortunately, they were very few of the whole skeleton. On making further inquiry during the afternoon, I found that "the quarry" (which I had supposed to be distant, on the west side of Scinde Island and near the harbour, where the larger quarries are,) was very near me, in Town Section No. 101, and opened on to Tennyson-street South. On hearing this, I called my man, (whom I could trust on such an errand,) and, showing him the little lot of bones, sent him to the quarry to see if he could find any more. On his return, he brought me three additional bones, two of them being the pelvis bones of the skeleton.

In more closely examining them on the following day, I was pretty sure they were bones of a small lizard, and probably a species of *Sphenodon*, but whether of the more common species, *S. punctatum*, or of some other species, I could not determine.

I had Dr. Newman's interesting account of his anatomy of a species of *Sphenodon*,* (*S. guntheri*, Buller,) but that treated chiefly on its muscles; and I had no works describing clearly the osteology of the *Sphenodon*, neither were there any in the library of the Hawke's Bay Philosophical Institute, save a partial drawing of its entire skull, in a plate in the "Zoology of the *Erebus* and *Terror* Voyage," but without letterpress or description.

Finding, however, that Dr. Günther's full and able description of the anatomy of *Sphenodon punctatum* was in the library of the Colonial Museum, where also was a preserved skeleton of the animal (mentioned by Dr. Newman in his paper referred to), I wrote to the Director of the Colonial Museum, Dr. Hector, for the loan of both skeleton and book, and very recently I have received both, for which kindness I wish to thank him.

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*"Transactions N.Z. Inst.," vol. x., p. 222.

Being thus aided for my task, I was enabled to go to work, and to examine and study the few bones I had obtained; and in this short paper I give you the result.

As I said at the beginning, the bones, unfortunately, were few. The total number of whole bones and pieces was but forty-three, several being small chippy portions of the skull that had separated at their sutures; fortunately the jaws with their teeth were among them, and nearly entire. Then, as regards their bulk, a wine-glass would have contained them all. Their complete list, as far as I have been able to make them out (through shortness of time), will run as follow:—

1. *Of the Head:* 6 bones, containing the teeth, viz.:—2 *maxillary*, 2 *mandibles*, and 2 *maxillary-palatal*; also 1 *splenial*, and 1 *articular* (belonging to one of the mandibles), 1 *os quadratum*, and 1, the basal portion of the skull, with *exoccipital* and other bones attached; with a few small, thin, chip-like bones and fragments.

2. *Of the Fore-limb:* 1 *humerus*, 1 *ulna* (whole), and 1 *radius* (part only).

3. *Of the Vertebræ:* 9 joints.

4. *Of the Body:* 8 ribs (some broken), and the pair of *pelvis* bones.

There was also among them what appears to be the tarsus of some small bird, but broken.

I will now give a more particular description of those bones, showing where I have observed them to differ from those of *S. punctatum*, as given by Dr. Günther.

Before, however, that I describe its teeth, I should observe that this animal, like *S. punctatum* and a few others, is a true *Acrodont*; that is, it has no proper teeth set into proper (alveolar) sockets like those of other animals; but its teeth are composed of little bony points, arising from the bone of the jaw itself,* and are of various shapes and sizes, so that it is difficult sometimes to decide whether a tooth or a projection should be considered as one or as three, from the number of its sharp,

*To this, I may be permitted to add in a note, that I was the first to point out this curious novelty; and this I did first to Dr. Dieffenbach (in 1841), from my living specimen, which I had and kept alive for several months. Dr. Dieffenbach then resided at Paihia, Bay of Islands, very near me, and visited me frequently; Dr. Dieffenbach, also, having at that time received from me the very specimen which Dr. Günther has stated in his admirable Memoir as being the *first* one taken to England, and deposited by Dr. Dieffenbach in the British Museum. (This is extracted by Dr. Günther from Dr. Dieffenbach's early work on New Zealand, vol. ii., p. 205, in which work, however, my *quondam* friend omitted to mention how and when he received it, as well as several other similar matters relating to specimens of New Zealand natural history, the Maori language, customs, etc., etc. Dr. Dieffenbach never visited the East Coast of the North Island.)

tooth-like points.* The teeth are mostly broadly conical, especially the maxillary, with their tips truncated or flattened, as if worn; and all with an apparent longitudinal flaw, or crack, extending down the centre of the tooth. At the same time, it seems to me that the structure of the substance of the teeth, from their semi-pellucid appearance, is different from that of the common bone of the jaws.

I. *Of the Teeth*:—

1. The *maxillary*, or upper jaws: One contains 16, and one 17 teeth, of which the central ones are the largest; in this respect differing largely from *Sphenodon punctatum* (Günther's).

2. The *mandible, dentary*, or lower jaws: One contains 16 teeth, and a canine one at the anterior end of the jaw, with no space between them; and one contains 13 teeth with the canine one, and a space between them. These dentary teeth are alternately large and small.

3. The *palatine* teeth also vary in number. In the one, there are 8, and in the other 10, teeth, the anterior tooth being the largest. This one agrees with *S. punctatum* (Günther's).

4. The *intermaxillary* teeth (if there ever were any) are missing.

Here, I may observe, that Dr. Günther says of the teeth of *Sphenodon punctatum*:—"There are originally about 18 in each maxillary, and 11 in each palatine. However, those of the anterior half of the maxillary appear to be soon ground down to the alveolar edge. . . . The first palatine tooth is much stronger than, and separated by a short interspace from, the succeeding. . . . The alveolar edge of the mandible is polished, bearing about 16 teeth as long as the number is complete; but (as in the maxillary) the teeth are gradually lost from the front backwards." Dr. Günther has also given several drawings of the teeth and jaws of *Sphenodon punctatum*, of both old and young specimens, but none of them agree with these of this specimen.

II. *Of the Dental Bones*:—

1. The upper jaw contains 10 *foramina maxima superiora*: of these, Dr. Günther merely says that "they are present as in other lizards."

2. The lower jaw contains 6 to 7 *foramina mentalia*: in *S.*

*As an apt illustration of this, I may here quote what Dr. Newman incidentally mentions in his paper above referred to:—"Drs. Günther and Knox disagree in the number of teeth assigned to each maxilla and palate, but this arises from the fact that Dr. Knox considers several of them complex teeth, while Dr. Günther counts each cone as a distinct tooth. Günther says there are about eighteen teeth in each maxilla, which Knox counts as six. I counted sixteen in mine, and thirteen on each palate."—(*l. c.*, p. 232.)

punctatum these latter "vary in number from 2 to 4, and are small." The additional large *foramen* between the dentary and articular bones, mentioned by Dr. Günther as being large in *Sphenodon punctatum*, is also found here in this specimen, and is very large. This lower jaw has lost its *coronoid*, which separated at the suture; the very small and splintery *splenial*, and *articular*, were also separated at their sutures, but these two were with the bones.

3. The *palatine*, with its additional row of bony teeth, is a highly curious bone; when this is fixed in its natural situation in the roof of the mouth, forming an extra line of teeth parallel with those of the upper jaw, the teeth of the lower jaw are so situated as to fall in, or close up, between those two lines.

III. *Of the Remaining Bones of the Skull:*—

1. The inner basal portion, with the *exoccipital* bones, is complete; these are, however, much smaller than those of *Sphenodon punctatum*, yet the occipital hole (*foramen magnum*) is considerably larger. There is a most peculiar isolated internal bone, arising centrally from above the anterior *hypapophysis* of *basis-phenoid*, and also the *pterygoid*; it is not thicker than a bristle, and about 4 lines long; it is semi-cylindrical, and curved upwards, and wonderfully preserved! There is no such a bone shown in Dr. Günther's careful and able dissections of the skull of *Sphenodon punctatum*; * but it exists, though smaller and stouter and scarcely seen, in the Wellington specimen (which is badly preserved).

2. The *os quadratum* (1 only) is much broader at the end than that of *Sphenodon punctatum*, as shown in Dr. Günther's plate; besides, the suture joining it to the *pterygoid* is of a different shape; it is also different from that of the Wellington specimen.

3. There are also a few other very small, thin bones, mere chips, separated at their sutures, and not yet ascertained.

IV. *Of the Fore-limb:*—

Of this, there are 1 *humerus*, 1 *ulna*, and 1 *radius*; the two former are whole, the latter broken. The *humerus* is very stout, and is a beautiful piece of mechanism. Dr. Günther gives no drawing of these bones (though he does of the adjoining *scapula* and *coracoid*), and says very little about them, save that "they are similar in form to those of other known genera of this family." These three bones resemble those of the Wellington skeleton as far as those can be seen.

V. *Of the Vertebræ:*—

1. There are only 9 joints; 4 *cervical*, of which one joint

* This bone, however, may have been referred to by Dr. Günther, in writing on the palate and its muscles, where he casually mentions "the long styliform process of the pterygoid and ectopterygoid." (*l. c.* p. 600.)

is the 2nd cervical; 3 *dorsal;* and 2 *caudal*, upper anterior. These are all much smaller, etc., than those (few) shown by Dr. Günther, especially the 2nd cervical.

VI. *Of the Remaining Bones of the Body:*—

1. There are 8 of the smaller ribs and portions of ribs, none being quite perfect. These are very much smaller than those shown of *Sphenodon punctatum.*

2. The pair complete of *pelvis* bones, which differ considerably from those of *Sphenodon punctatum* (as represented in the drawing), in wanting the "remarkably developed uncinate process of *os pubis*, in the middle of their anterior margin, and the still more prominent *tuberositas ischii*" of the posterior angle. Those processes, however, exist in this pair of pelvis bones, but they are smaller, and of a different shape; while those same bones in the Wellington specimen are very much larger and stouter every way.

I regret not having had more of the bones of this little animal, especially those of the upper and fore parts of the head, with the intermaxillary teeth; more of the fore-limb, also those of the hind-limb, and more joints of the vertebral column. Of these latter alone—which joints in *Sphenodon punctatum* amount to 63, all varying exceedingly with their position in the skeleton—there are in this small lot only nine joints, or one-seventh of the complete number!

The whole of the bones of this newly-found specimen are remarkably thin, almost papery (except those three of the fore-limb), and yet generally perfect, and not worn down by friction or wasting. Their thinness, combined with the more sound and larger teeth, serve to show that this animal must have been young, or, at all events, not a very old one; and yet the teeth are very far from approaching to those of a young one, as shown by Dr. Günther. Again, there is no comparison as to general appearance between these bones and those of the Wellington specimen, which are both larger and stouter, and apparently of a different substance. These bones must have belonged to a much smaller animal than either *Sphenodon punctatum* of Dr. Günther, or that of the Wellington skeleton. At the same time, it must not be overlooked that the *dentary* bone (or lower jaw) of this specimen is quite as large as that of *Sphenodon punctatum* of Dr. Günther, and a little longer than that of the Wellington one.

These bones are not fossilized, neither are they rotten, although so very thin. The old Maoris always said that the tuatara (*Sphenodon* sps.) formerly inhabited the headlands of the New Zealand coast (as well as the islets lying off it), which the finding of this specimen proves. The place where it was found is on the east side of the outer hill forming Scinde Island (Napier),

which originally formed a steep slope to the raised beach below. The remains were discovered at a depth of about 45 feet from the surface of the slope, and about 40 feet in from the base, in apparently undisturbed sandy loam. My own opinion is—from having, thirty to forty years ago, seen remarkably large and deep new rents and fissures in the sloping sides of our Hawke's Bay hills, caused by earthquakes, many of them afterwards closing up,—that anciently this little animal, at some such a season, fell into one of those deep rents, and so perished.

In conclusion, I may observe that Dr. Newman also says:—"Three species of *Sphenodon*, unlike in form and colour, have been discovered: 1. *Sphenodon punctatum*, black and spotted; 2. *S.* (unnamed), green and yellow; 3. *S. guntheri*, lighter. The dark form is found in the North, the intermediate at East Cape Islet, and the lighter form in the South. *S. punctatum* was the form so elaborately described by Dr. Günther. The other species have not been anatomically examined."*

Dr. Günther also mentions the possibility of there being two species, although, from the smallness of the material before him at that time (1867,) he does not support it.

Such, however, being the case, and these (few) bones not wholly agreeing with those of *Sphenodon punctatum*, I have named this species *Sphenodon diversum*, but only provisionally, as on further examination of both this and of better specimens, and a closer comparison of them with the bones of those two other specimens mentioned by Dr. Newman, may yet show that these belong to one of those two species.

P.S.—The ordinary meeting of the Hawke's Bay Philosophical Institute, to be held this evening, being the last for this season and year, I have been very desirous of bringing this paper before you, and have only been able to finish it this day.

ART. XXIV.—*A List of the Native Birds of the Petane District, Hawke's Bay, with Notes and Observations.*

BY A. HAMILTON, of Petane.

[*Read before the Hawke's Bay Philosophical Institute*, 1885.]

THE district over which the birds occur, enumerated in the following paper, may be defined as the country lying between the two rivers, the Tutaekuri and the Mohaka. Included between these natural boundaries will be found a great diversity of feeding ground for the various kinds of birds, the tidal flats and estuaries of the Inner Harbour of Napier, the river-beds of the

*l. c., pp. 222, 223.

Esk and its tributaries, the fern-covered hills near the Mohaka, and the bush at Pohue, with the smaller patches of bush still remaining in many places at the heads of valleys; all these combine to furnish a very fair proportion of genera and species. The beautiful bay itself is visited in stormy weather by a number of oceanic species, many of which still remain unrecorded. Much remains to be done in ascertaining the local distribution of our New Zealand birds, and, as a contribution to this end, it is hoped that this list may be of service.

1. Hieracidea novæ-zealandiæ, *Lath.*—Quail Hawk.

This beautiful little hawk is not at all common in the district. I have only seen it four times in six years. It is curious to find this bird so scarce, as it is rarely destroyed by man, and can scarcely have any natural enemies.

3. Circus gouldi, *Bonap.*—Harrier.

Now this species has been persecuted and destroyed in considerable numbers for many years past, by gun and trap, in the interests of imported game birds; and yet it is almost ubiquitous, and may be seen from sun-rise to sun-set sweeping in wide circles over the hills. The reward offered by the Acclimatization Society for their destruction caused the death of a very large number, their carrion-loving propensities bringing them to an ignominious fate in the rat-trap. The damage done to the game birds by hawks is, I am inclined to think, very small compared with the ravages of the cats which infest the country, and, to a lesser extent, by the weka (*Ocydromus*). That the hawk varies its diet by occasionally devouring eels I can affirm, having, as I found by reference to my notes, twice surprised hawks feeding on them in the bed of a shallow creek.

5. Athene novæ-zealandiæ, *Gml.*—Morepork.

8. Halcyon vagans, *Less.*—Kingfisher.

Builds, or rather makes its nesting-place, in sandy cliffs at the edge of the Petane river-bed. Last season there were five nests made in the face of a bank, the holes reminding one of the sand martins in England. The holes were about five feet from the base of the cliff, and penetrated to a depth of three feet, and contained on an average five eggs each. I am informed by a person who took some of the eggs, that there was a considerable range of variation in both size and shape.

During the breeding season we do not see much of these birds, but when the young brood are fledged—and especially if the weather be wet and the ground soft—they become one of the most obtrusive of our feathered friends. On several occasions I have seen kingfishers in the act of killing and eating mice, and instances have been reported of their killing small partly-fledged birds.

10. PROSTHEMADERA NOVÆ-ZEALANDIÆ, *Gml.*—Tui.

Frequent in the bush. Occasionally visiting the cultivated lands and the neighbourhood of the houses, when the blue gums are in flower.

13. ZOSTEROPS LATERALIS, *Lath.*—White-eye, Blight Bird.

One of our best friends, and abundant in all parts of the district. The history of the invasion of New Zealand by this bird is one of the most interesting chapters in our zoological record.

19. SPHENŒACUS PUNCTATUS, *Q. & G.*—Fern Bird.

The peculiar chirp of this lively little bird is yet to be heard among the tall fern, though it is not so plentiful as in days gone by. It is probably diminishing in numbers before the march of civilization.

22. GERYGONE FLAVIVENTRIS, *Gray.*—Warbler.

In every garden and grove of trees.

26. PETROICA TOITOI, *Less.*—Pied Tit.

28. PETROICA LONGIPES, *Less.*—Wood Robin.

31. ANTHUS NOVÆ-ZEALANDIÆ, *Gml.*—Lark.

An egg was found this year quite pink; three other eggs in the same nest were perfectly normal.

34. RHIPIDURA FLABELLIFERA, *Gml.*—Pied Fantail.

35. RHIPIDURA FULIGINOSA, *Sparrm.*—Black Fantail.

I obtained a specimen of this bird in the Pohue Bush, about 20 miles north of Napier, July 7th. I have seen it occasionally nearer Napier. In 1876 I got two or three in the Horokiwi District, near Wellington. Several other instances are recorded in the volumes of the Transactions; and probably it will be found that, though much more plentiful in the South Island, it should be considered a species common to both islands.

43. PLATYCERCUS NOVÆ-ZEALANDIÆ, *Sparrm.*—Parrakeet.

47. NESTOR MERIDIONALIS, *Gml.*—Kaka.

This bird, like the tui, comes down to the gum-trees when they are in flower. In the bush parts of the district it is common.

50. EUDYNAMIS TAITENSIS, *Sparrm.*—Long-tailed Cuckoo.

The long-tailed cuckoo pays us a yearly visit, and this season a solitary bird remained in the Petane Valley very much later than usual, as I saw it several times during the last week of March. Has any instance been recorded of its remaining in the country, or would this bird have to take its journey of 1,500 or 1,600 miles to the Society or Friendly Islands by itself?

51. Chrysococcyx lucidus, *Gml.*—Shining Cuckoo.

Our bronze cuckoo is always welcome as the herald "of sunny days to be," and has yet another claim upon us as a practical destroyer of some of our insect pests. Mr. Gilberd, of Taradale, has informed me that for some seasons past he has noticed these birds feeding on the different scales and blights so much dreaded by all horticulturists; and he is convinced that they do a large amount of good. It is well that the services thus rendered by our summer guest should be published abroad, as it may restrain the murderous instincts of some of those who, if they see a pretty bird, must needs immediately try and shoot it.

52. Carpophaga novæ-zealandiæ, *Gml.*—Pigeon.

54. Apteryx mantelli, *Bart.*

Two specimens were taken alive in the Pohue Bush in 1880, and I believe it is still to be found on the slopes of Maungaharuru.

59. Charadrius obscurus, *Gml.*—Red-breasted Plover.

60. Charadrius bicinctus, *Jard.*—Dotterel.

Breeds on the river-beds. The eggs vary considerably in density of marking.

65. Hæmatopus longirostris, *Viell.*—Red-bill.

66. Hæmatopus unicolor, *Forst.*—Black Red-bill.

Both of the Red-bills frequent the sandy shoals and banks near the Port Ahuriri bridge.

69. Ardea sacra, *Gml.*—Blue Heron.

Although this bird occurs plentifully both north and south of the bay, I have only seen one specimen, which was resting on the western spit.

71. Ardea pœciloptera, *Wagl.*—Bittern.

This noble bird is remarkably numerous in the lagoons and swamps of the district. I have frequently seen during this month (April) as many as nine in sight at one time in the lagoon by the side of the Taupo Road, at Petane. Some years ago, when shooting at Tongoio, I put up sixteen in one day.

75. Limosa baueri, *Naum.*—Godwit.

79. Himantopus leucocephalus, *Gould.*—Pied Stilt.

80. Himantopus novæ-zealandiæ, *Gould.*—Black Stilt.

Both of these occur very plentifully, and breed on the islands in the harbour and on the river-beds. The vigilance of these birds is extremely annoying when in pursuit of ducks, as their harsh note of warning is quickly appreciated by any ducks in the neighbourhood.

81. HIMANTOPUS ALBICOLLIS, *Buller*.—White-necked Stilt.

Occurs not unfrequently.

85. OCYDROMUS EARLI, *Gray*.—Wood-hen.

Has increased very much in numbers within the last four or five years, and more especially near the swampy estuaries of the harbour. A nest taken November 10th contained four eggs, and the female bird caught on the nest contained another egg fully developed. The nest was simply a heap of dead grass under a rush bush, in a brackish water swamp.

90. RALLUS PHILIPPENSIS, *Linn*.—Striped Rail.

This elegant Rail is more plentiful in this district than I have seen it in any other part of New Zealand, excepting, perhaps, Okarito. The large rush-covered marshes near the mouth of the Petane River seem its chief stronghold. On the 14th March, this year, I caught, with the help of my dog, a female, and one out of a family of five chicks. The young were about half-fledged, and were most curious little things. I exhibited to this Society last year the egg of this bird.

93. ORTYGOMETRA AFFINIS, *Gray*.—Water Crake.

A cat belonging to a neighbour has brought me in, during the years 1881–83, seventeen specimens of this Crake, and twelve specimens of the next species (*O. tabuensis*). Both of these birds abound in the raupo swamps of the district, but are extremely difficult to obtain, unless a friendly "mouser" takes the matter in hand.

94. ORTYGOMETRA TABUENSIS, *Gml*.—Swamp Crake.

96. PORPHYRIO MELANOTUS, *Temm*.—Swamp Hen.

98. CASARCA VARIEGATA, *Gml*.—Paradise Duck.

Bred two years ago, in a swamp in the Petane Valley.

100. ANAS CHLOROTIS, *Gray*.—Brown Duck.

101. ANAS SUPERCILIOSA, *Gml*.—Grey Duck.

Has been crossed with the domestic duck by a gentleman living in the district, as recorded in the Transactions.

102. RHYNCHASPIS VARIEGATA, *Gould*.—Shoveller, or Spoonbill.

This beautiful species is not at all uncommon about the district. Indeed, I think that in some seasons I have shot as many Spoonbills as Grey Ducks, probably owing to their being more easily approached.

103. HYMENOLÆMUS MALACORHYNCHUS, *Gml*.—Blue Duck.

104. FULIGULA NOVÆ-ZEALANDIÆ, *Gml*.—Black Teal.

108. PODICEPS RUFIPECTUS, *Gray*.—Dab-chick.

Several pairs of these pretty birds breed every year in the Tongoio Lagoon. In March last, I watched for some time a

family party, the two old birds and four young ones, preening their feathers in the sun, and keeping together in a most sociable manner.

111. Larus dominicanus, *Licht.*—Black-backed Gull.

112. Larus scopulinus, *Forst.*—Mackerel Gull.

114. Sterna caspia, *Pall.*—Large Tern.

115. Sterna frontalis, *Gray.*—Sea Swallow.

116. Sterna antarctica, *Forst.*—Common Tern.

117. Sterna nereis, *Gould.*—Little Tern.

Only after or during heavy weather.

119. Diomedea exulans, *L.*

120. Diomedea melanophrys, *Boie.*—Mollymawk.

One picked up on the Tongoio beach, March, 1884.

129. Puffinus brevicaudus, *Brandt.*

130. Puffinus tristis, *Forst.*—Mutton Bird.

138. Procellaria fuliginosa, *Kuhl.*—Sooty Petrel.

143. Prion turtur, *Sol.*—Dove Petrel.

144. Prion vittatus, *Gml.*—Broad-billed Dove Petrel.

149. Dysporus serrator, *Banks.*—Gannet.

150. Phalacrocorax novæ-hollandiæ, *Gould.*—Black Shag.

This bird is at present a proscribed individual, a reward of 1s. 6d. being offered for every head.

156. Phalacrocorax brevirostris, *Gould.*—White-throated Shag.

This small Shag breeds in trees by the side of the Petane River, some distance above the confluence of the Kaiwaka Stream.

159. Phalacrocorax punctatus, *Sparrm.*—Spotted Shag.

Of the Spotted Shag, I have seen but two specimens in the harbour; one was shot at Kaierero in 1882.

169. Eudyptes pachyrhynchus.—Crested Penguin.

175. Eudyptula minor, (?) *Forst.*

I saw one swimming in the surf in January, 1884. Very scarce on this coast.

Art. XXV.—*A remarkable Variety of the New Zealand Pigeon* (Carpophaga novæ-zealandiæ), *with References to previous Notices.* By T. W. Kirk.

[*Read before the Wellington Philosophical Society, 24th June,* 1885.]

Head, neck, and fore part of breast, which in ordinary specimens are shining gold-green, are here thickly strewn with white feathers. On the fore-neck, the coppery purple band is replaced by a large patch of pure white feathers. The nape, shoulder, and upper surface of wings are also thickly strewn with white feathers; back and uropygium have likewise many white patches, but getting fewer towards the latter portion. The bright green of the breast is succeeded by a band of pale grey, which fades as it approaches the abdomen. Quills and tail-feathers, normal colour. In no instance is a parti-coloured feather to be found, the white feathers being pure; even the shafts are destitute of colour.

Eyes, pink, not carmine-red, as is usual. Feet, paler than customary; the soles flesh colour, rather than yellow. Bill, normal colour.

This specimen was shot at Eketahuna, in the Seventy-mile Bush, Provincial District of Wellington, by Mr. R. R. Greville, and by him presented to the Museum.

References.—Buller, "Birds of N.Z.," p. 158; "Trans. N.Z. Inst.," vol. viii., p. 196.

Kirk, T. W., "Trans. N.Z. Inst.," vol. xii., p. 248.

Art. XXVI.—*Notice of an Instance of Abnormal Colouring in* Platycercus auriceps, *with Record of previous Notices of similar Variations.* By T. W. Kirk.

[*Read before the Wellington Philosophical Society, 24th June,* 1885.]

On looking for previous notices of the occurrence of variations from the type of this species, they were found to be so scattered, that the thought struck me it might be of some help to students of ornithology if they were collected together into one paper. I have therefore prepared the description of the specimen now on the table, with a record of all previous notices that I could find; and trust that the list is tolerably complete.

1. Mr. H. H. Travers (see "Trans. N.Z. Inst.," v., p. 216, 1872), in a paper on the Birds of the Chatham Islands, says: "I obtained a specimen on Mangare with a faint yellow tinge on the head."

2. Mr. Potts ("Trans. N.Z. Inst.," vi., p. 148, 1873): "A specimen with yellow plumage."

3. Dr. Buller ("Birds of N.Z.," p. 61) describes three instances:—

(*a*) A young bird taken from the nest, "and not fully fledged, had the plumage of the body pale yellow, shaded with green on the upper parts, and the quills and tail-feathers marked with red."

(*b*) "Another had numerous light crescentic marks on the wing-coverts."

(*c*) The third, captured in the Manawatu, had quite a dazzling combination of colours: "Frontal band, crimson; vertex, golden yellow; space round the eyes, and a band encircling the neck, green; head, shoulders, and lower part of back, red, and the intermediate space variegated with red and green; quills dusky, obscurely banded with yellow, and margined on the outer web with blue; wing-coverts greenish yellow, barred and margined with red; tail feathers green, obscurely barred with yellow in their apical portion; under-parts green, variegated with crimson and yellow; an interrupted band of the former colour crossing the breast."

This specimen was kept in confinement, and during the moulting season was fast losing its distinctive colouring, when it was accidentally killed.

4. The sixth example is the specimen now before you. The general plumage is of a beautiful canary yellow. A band of dark crimson connects the eyes, passing across the forehead just above the base of the bill. The crimson spot on either side of the uropygium is larger and much more brilliant than in the normal specimen. Quills and tail-feathers yellow, but with patches of blue, green, and dark brown, except the under tail-feathers, which are a rich yellow; shafts of all feathers white. On raising the feather the underneath downy portions are seen to be pure white, instead of blueish slate, as is usual. Bill, white; feet, yellow; legs normal colour.

This beautiful specimen was captured at Takaka by Mr. Fabian, telegraph lineman, in whose possession it was seen by Dr. Lemon, to whose intercession the Museum is indebted for the donation.

ART. XXVII.—*On the Habits of* Ocydromus australis.

By W. W. SMITH.

Communicated by Dr. Buller, C.M.G., F.R.S.

[*Read before the Wellington Philosophical Society, 25th November, 1885.*]

IN offering some observations on the South Island Weka, I desire to lay before the Society some account of the habits of this interesting and useful species, as it exists at present in the more settled districts. It is undeniable, and certainly to be deplored, that in some localities this valuable bird is rapidly disappearing; not, however, from natural causes, as want of food or shelter, but from the manner it is assailed and destroyed by man, impelled by an ignorant and mistaken prejudice. Too much cannot be said in favour of the Weka, and all prejudice would soon be overcome, as anyone who would give a little attention to its habits could soon observe. The mere destruction of a few eggs in or near the poultry yard, or disturbing a few pheasants in reserves, may be overlooked, compared to the inestimable services they render in destroying vermin.

The Weka's "struggle for existence" is greater than any other native bird. Thousands perish annually in the fires which sweep over large areas of tussock lands. It is mercilessly destroyed with dog and gun, while numbers fall victims to poisoned meats, laid for hawks; but the most deadly enemies it will now have to contend with are the recently-introduced stoats and weasels; and if these voracious and nimble little mammals flourish in our country, not many generations will elapse before the "last of the Wekas" shall be recorded.

In cultivated districts they are more wary and more nocturnal in their habits, generally remaining concealed during the day in gorse hedges, patches of scrub, or swamp, or in plantations of English trees. In the evening they leave these haunts and roam over the fields, feeding chiefly on worms, which they draw from their burrows and consume in large numbers. They are of great service to the squatters and farmers in consuming the larvæ of *Odontria*, which devastate lawns and English grass paddocks. The larvæ live beneath the surface of the soil, subsisting on the roots of grasses. The roots are eaten close to the surface, leaving the plant to shrivel and die, or to be blown away by the wind. In the morning large patches may be seen fresh turned over during the night, by the Weka digging out and consuming them. When a brood is hatched near paddocks infested with these grubs, the parent birds lead them there, and dig vigorously over the ground, rooting them out with their powerful bill to feed their young. If encouraged about homesteads, they are heard during the night tapping on the walls of dwelling and

out-houses, picking off the spiders and insects secreted there; when bags or sheepskins are found lying on the ground, they drag away or turn them over, to procure the worms, beetles, or woodlice hidden beneath. Occasionally, during their nocturnal rambles, they discover the carcase of a sheep; they commence pulling off the wool until they effect an opening in the flesh; here they fare sumptuously for weeks, often secreting themselves in the nearest cover, and returning night after night to feed on the carcase, or the maggots, which in their turn devour it. They are also expert destroyers of rats and mice, and assist materially in destroying the numbers of young rabbits in infected districts.

The omnivorous habits of the Weka favour it more than any other native species to withstand the change produced by cultivation. It would survive when all other known species of Rail would soon become extinct. It is equally at home among cultivated gardens and fields, as well as in its native tussock, swamp, or bush.

The call is an excellent barometer; but the call which indicates rain is readily distinguishable from its ordinary answering call—it is more incessant, and repeated at shorter intervals. The ordinary call, or cry, is invariably led off by the female, and is answered in all directions by both sexes. This, however, is only peculiar to paired birds before or after meeting, as the male or female is often heard, solitary, answering others in the distance, while its mate is on the nest. The preparation of the ground, gathering of the tussock grass, and building of the nest is performed by both birds alike. They are fastidious in their choice of a site, going over the same spot many times before it is selected. The nest is placed under a tussock (*Poa*) or niggerhead (*Carex virgata*); it is found in clumps of *Discaria toumatou* and *Pteris aquilina*, and I have seen it twice placed under a bare rock, but the gorse hedge is preferred, as affording better protection from the attacks of dogs. One I observed last year, made by a half-tame pair, was completed in two days. The grass is placed in a loose heap on the spot selected; the nest is shaped by the bird squatting on the material, and turning round until a hollow is made; it then draws the grass around its body with the under surface of the lower mandible until it is completed. After the completion of the nest alluded to, one day elapsed before laying; one egg was then laid each successive morning; when it contained four, they began to hatch, the female generally remaining a little longer on the eggs than the male. At this season they have a muttering or suppressed call; if the sound is carefully imitated, it is an easy matter to find a weka's nest, provided it is approached cautiously, or unperceived by the birds. When a nest is found, the finder may rest assured there is not another near for a considerable

distance. The young make their appearance on the twentieth day, and remain in the nest three or four days before the mother ventures out with them; the chicks are shy and wary, and hide on the slightest alarm given by the parent birds. The male is untiring in its efforts to procure food, and often rambles far from the brood; when a suitable morsel is found it runs hurriedly back to them. The morsel, whatever it may be, is usually seized by the female while in its mate's bill. Often enough food for days is strewn around the brood, so persistent is the male in its efforts to procure food. Both parents are furious in defence of their young; if a chick is caught, and caused to make a distressing cry, both birds rush around with open beak, and utter a barking discordant noise. I have often seized both birds with my hands by this means.

The young attain maturity in the fifth and sixth month; they are deserted by the parent birds about the fourth month, the latter generally laying again and rearing a second brood; if the nest is robbed, or the young removed from them, they will lay three and four times. Eggs and young can be obtained in this district (Oamaru) all the year round. The Weka's age can be determined by the colour of the eye, the legs, or plumage. The bright scarlet iris is acquired the second year; the silvery plumage of males, or the bright red legs of females, is an unmistakable sign of good age in both. Once paired, they will remain permanently so.

When enclosed in small yards they become tamer than domestic fowls, thrusting their heads through the meshes of the wire and feeding from the hand. For two seasons I have confined female wekas with domestic game-cocks, for the purpose, if possible, of procuring hybrids between the two species, to endeavour to settle the question of alleged crossing, but thus far without success; although they lay freely, the eggs have been unfruitful. If the eggs are removed immediately after laying, they lay four and five times during the year, producing fifteen or twenty eggs.* The wing-spurs appear to have been acquired for defensive purposes alone, as I am unable to detect any other purpose they serve in the bird's economy. The females do not use the spurs much, one or other generally running away, hotly pursued by its assailant. The chase is often kept up till both are exhausted. The males are more pugnacious, and do not run so readily. When fighting, and facing each other, the wings are elevated or arched over the back, the neck is drawn in under cover of the wings, while the spurs are

* This season, three young females, reared in confinement, have laid seven dozen and two eggs, one bird laying three dozen and two of this number; the latter from the first week in September to the present time, December 7. The two others laid two dozen and three from August 25th, and one dozen and nine from August 28th, respectively.

pointed forwards. During a combat they injure most the back of the head. If examined after it, they are found to be wounded only on the head and neck. Along with the bruises produced by the hard bill are punctures caused by the wing-spurs. The latter are always more numerous at the base of the bill, and about the eyes, rarely extending down the neck. For a few days after the battle the head is swollen and hard, the neck is stiff and carried forward, but when near abundance of cold water they soon recover.

I know several authentic instances of the wekas' thievish tricks; one will suffice to show how dearly it pays at times for some inquisitive freaks of its nature. Six years ago a weka entered a bushman's hut in Peel Forest, during his absence. After springing on to the table it tasted the meat, the butter, and bread, and ungratefully tumbled the remainder on to the floor, endeavouring no doubt to carry them off. Failing this, it took with it, as the bushman asserted, "one of a new pair of Sunday boots." Although the loss of food, or injury to the carpet or crockery was small, and the new Sunday boot left only a few paces from the door, the bushman was avenged. In less than a month after the occurrence, he informed me, with his dog and gun he had killed forty wekas.

It is melancholy to notice the species disappearing from districts where only a few years ago it existed plentifully. Its presence is a boon to agriculture, and I trust the good qualities I have mentioned will commend the weka to the protection of the colonists.

Art XXVIII.—*Description of Hybrid Ducks, bred from Common Duck* (A. boschus) ♀ *and Grey Duck* (A. superciliosa) ♂.

By Taylor White, Glengarrie, Napier.

[*Read before the Hawke's Bay Philosophical Institute,* 1885.]

About nine years ago the grey drake (*A. superciliosa*) was trapped in the Wakatip Lake District, and readily became tame, but was very shy with strangers. In the third spring it paired with a domestic duck (*A. boschus*). A brood of six hybrids were reared.

No. 1. These mainly partook in type of the domestic duck, but were smaller, more plump in shape; colour, a creamy brown with darker markings, inclining to white on lower part of breast, throat, and cheek; a dark line passing through the eye, as in *A. superciliosa*; beak, brownish yellow; legs, dull yellow; speculum blue, outer black, margined with white, as in domestic duck. The drakes very similar to English wild duck (*A. boschus*), and having the curled tail-feathers; speculum, blue. Could fly fairly well, but with reluctance.

No. 2. One of these half-bred ducks mated with a grey drake (*A. superciliosa*), and one duck was reared, which in colour and size was almost identical with *A. superciliosa*, but had the speculum green, margined with white, and a slight touch of white on some of the secondary feathers of wing. Could fly strongly.

No. 3. This duck, when mated with a grey drake (*A. superciliosa*), produced a brood in type and colour like *A. superciliosa*, some of which have reverted to a wild state. For several seasons the first brood have been all dark-coloured, and the second brood always includes pure white, or albinos, and white with markings of dark pencillings and rufous; speculum, green; dark-coloured bill and legs; curled tail-feathers wanting.

No. 4. A drake, bred *inter se*, might be described as in foundation colour like *A. superciliosa*; slightly tinged on head with green; light colour on cheeks, dark mark through eyes; breast, rufous; speculum, green; tail, and tail coverts, inclining to black, edged with brown; two small curled feathers in tail.

No. 5. This season, in a brood of six, reared by a hybrid duck, which might be easily mistaken for a coloured call duck, which was mated to *A. superciliosa*. The ducks were slightly larger than *A. superciliosa*; foundation colour and markings similar, having a washed-out look; sides of breast forward of thigh, white grey, same as lower part of breast of *A. boschus*. Bill, some blackish green; legs the same. Others, bill yellow, chequered with black; legs, yellowish black; speculum, green, outer edge black, margined with white band above and below. The drake was identical in general appearance to *Anas boschus*: green head, white ring on front of neck, one curled tail-feather only. Colour of speculum, green, margined with white. Can fly, but are thoroughly domestic. As in the mallard, the bright colouring changes with the seasons.

The hybrids lay twice in the season, but few young are reared owing to want of convenient water; and numbers are destroyed by dogs, cats, hawks, and rats. The latter are very destructive.

ART. XXIX.—*Note on a large Sun-Fish* (Orthagoriscus mola, L.), *recently captured at Napier, Hawke's Bay.*

By A. HAMILTON, of Petane.

[*Read before the Hawke's Bay Philosophical Society, 8th June, 1885.*]

A FINE Sun-Fish (*Orthagoriscus mola*, L.) was recently thrown on shore, close to the Port of Napier, in a dying condition; I was fortunate enough to see it soon afterwards, and took measurements and sketches of all the important features. I also

took steps to secure the skin for stuffing, and, in the course of removing the skin, the men who did the work cut the greater part of the body to pieces, and they brought me some very curious teeth which they obtained a considerable distance down the throat, and, as far as I can learn, immediately between the branchial openings. The teeth were about one inch in length, the upper portion slightly curved, longitudinally striated, and gradually diminishing in diameter from the base to a sharp point. There were three rows of these teeth on each side of the pharynx, and the numbers may be expressed thus: 7, 9, 6, and 8, 9, 6. Three of these teeth are clearly accidental, one on the first row of the one side, and two on the first row of the other side, thus leaving the formula 6, 9, 6 and 6, 9, 6. The teeth are immovably fixed in solid cartilage, and when fresh there was between each row a thick fleshy gum or pad, which nearly covered the teeth.

Pharyngeal teeth are not uncommon in fishes, but I have not been able to find any mention of them in the Sun-Fish or other *Gymnodonts*. Another observation may, perhaps, be interesting. When I examined this fish on the beach, the surface of both jaws was covered with a kind of enamel, and felt perfectly smooth to the touch. When I received the skin, and had leisure to examine it closely, I found that rough handling, owing to the huge size and weight, had caused the enamel to scale off, and had left the jaws, which were now rough, presenting a surface resembling the shagreen of the dermal papillæ; but at the back edge of both upper and lower jaws were the original teeth of the fish, in size and shape much resembling grains of rice. These, I find from books, are serviceable in the earlier life of the fish, but when it attains a large size, these are absorbed (or are said to be). They seem, however, to be simply left behind by the growth of a broad horizontal layer of calcified tissue, which is covered on the top with a thin coat of enamel.

The great size of this specimen, 8 feet 1½ inches in length, and 5 feet 6 inches in depth, not including the dorsal and anal fins, would probably indicate an advanced age. The bony osselets, which are said to carry a spine in young specimens, were present, but their presence could not be detected in the living state. They were about the size of a duck egg.

Postscript.—A specimen of the Spinous Shark (*Echinorhinus spinosus*) has been captured in Hawke's Bay this month (September, 1885); it has been previously recorded in New Zealand waters by Prof. Parker, "Trans. N.Z. Inst.," vol. xvi., p. 280.

ART. XXX.—*On a New Species of* Chromodoris.

By T. F. CHEESEMAN, F.L.S.

[*Read before the Auckland Institute, 1st June,* 1885.]

A FEW months ago, Captain Farquhar, of the steamer *Clansman*, very kindly brought to the Auckland Museum a living specimen of an exceedingly handsome *Nudibranch*, found by him on the rocks at Whangaroa Harbour. Since then I have also had specimens in alcohol, of the same species, sent to me from Whangarei Heads. It proves to be undescribed, and to belong to the genus *Chromodoris*, of which only one species was previously known to inhabit our coasts—viz., *C. aureomarginata**, a pretty little animal occasionally seen in Auckland Harbour. Captain Farquhar's species is larger, and much more brightly and vividly coloured. The following is a description :—

Chromodoris amœna, n. sp. Body 1¼ to 2 inches long, linear-oblong, rounded in front, pointed behind, back slightly convex. Mantle smaller than the foot, quite smooth and even, pale pinkish or purplish lilac, with a central row of large bright orange oblong spots, and occasionally a few lateral ones, margin pale creamy or yellowish white. Dorsal tentacles (*rhinophores*) clavate, completely retractile within slightly raised sheaths; upper part arched backwards, laminate, laminæ from 24 to 25. Branchiæ completely retractile, 10 in number, connected at the base, small, erect, linear, simply pinnate. Both tentacles and branchiæ are a bright magenta colour. Oral tentacles free, small, conical. Foot paler than the mantle, the sides and extremity with an irregular double row of roundish bright orange spots, considerably longer than the mantle; sole, pale flesh-colour. Odontophore of about 65 rows of teeth; central tooth small, laterals from 60 to 70 on each side. Mantle spicules apparently wanting. Ova deposited in a spiral coil of four turns.

Captain Farquhar's specimen lived in confinement for more than a month, during this period depositing its ova. It was lively and active in its habits, and was fond of floating in a reversed position just under the surface of the water, as is the case with many of the *Nudibranchs*. Its graceful form and bright colours render it one of the handsomest species yet discovered in New Zealand.

* "Trans. N.Z. Inst.," vol. xiii., p. 223.

Art. XXXI.—*On a new Paper Nautilus* (Argonauta bulleri).

By T. W. Kirk.

[*Read before the Wellington Philosophical Society, 24th June,* 1885.]

Plate IV.

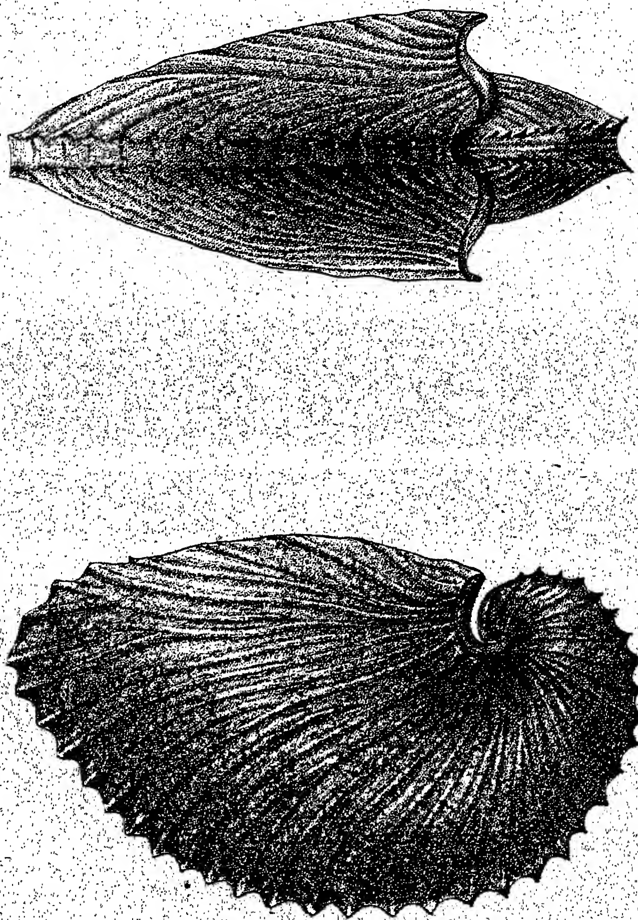
It may be remembered that last year I had the pleasure of exhibiting quite a fleet of "paper nautilus," and of describing a new species (*A. gracilis*), for several specimens of which I was indebted to Mr. C. H. Robson, of Portland Island. That gentleman then informed me that he believed there was a third species on the New Zealand coast, but that he had never been able to obtain a perfect specimen. In the "New Zealand Journal of Science" for May, 1884, he mentions having obtained a perfect shell; and in a letter lately received he says: "I told you of a supposed new species of *Argonaut*, found by me on Portland Island in March, 1884. . . . I will ask you to examine, describe, and name the specimen which I now forward to you. If it is new, I should like it named after our mutual friend Dr. Buller, who, notwithstanding all he has done for the natural history of New Zealand, has only one bird dedicated to him. . . . For some time before I obtained the shell which you will receive, I felt sure that a third species visited our shores, having found fragments of shells which did not seem to belong either to *A. tuberculata* or *A. gracilis;* but on account of the fragility of the shells in question, the pieces were always too small for practical use, till I obtained the nearly perfect specimen which you will receive, and which you will at a glance perceive is quite distinct from either of the two species above named. I wish to present it to the Colonial Museum, if new, as a type specimen."

As I have no doubt about its being a new species, I have great pleasure in complying with the discoverer's wish, and naming it after New Zealand's premier ornithologist.

Description.—Shell translucent, sides much compressed, especially towards the keel, giving the aperture a hastate shape; sides with numerous transverse plications, which are *not* tuberculiferous, sides project near the spire into wing-like processes, similar to those of *A. tuberculata*, causing this end of the aperture to look nearly straight. Keels very close together, with small compressed tubercles; colour, white.

Loc.—Portland Island.

This shell is very much thinner, more fragile, and of finer texture even than *A. gracilis,* and may be distinguished by the general form of the shell, the shape of the aperture, the angle at which the wings spring from the sides, the much narrower space between the keels, and by the plications being true, not



ARGONAUTA BULLERI. n. sp.

made up of numerous tubercles as is the case with *A. tuberculata* (Shaw), and *A. gracilis* (*mihi.*) The nearest species is apparently *A. argo*, from which it is distinguished by the wing-like processes and other minor differences.

ART. XXXII.—*Description of a new Pill-Millipede.*

By T. W. KIRK.

[*Read before the Wellington Philosophical Society, 23rd September*, 1885.]

THE *Myriapoda* have occasioned much diversity of opinion amongst naturalists in time gone by. Some have classed them with insects, some with spiders, and some with Crustacea, for they possess characters allied to each of these; but the distinction of a separate class is now generally accorded them, and this class is divided into four orders. I. *Chilopoda*, contains the carnivorous centipedes. II. *Chilognatha*, the vegetable-eating millipedes (*Iulidæ*), the gallyworms (*Polydesmus*), and the pill-millipedes. III. The third order was created for the reception of a peculiar little animal, one-twentieth of an inch in length, which possessed characters totally different from those of any member of the two orders previously mentioned. This little creature was discovered and described by Sir J. Lubbock. IV. The fourth order contains that extraordinary genus of animals found in the West Indies, South America, South Africa, and New Zealand; I refer to the *Peripatus*. So puzzling are the characters presented by this genus, that it has been at different times referred to the errant *annelids*, the leeches, the tape-worms and the *Myriapoda*; in the last-mentioned it remains for the present. And though its position is by no means satisfactory, it yet appears to be more nearly related to the *Myriapods* than to any other group.

The animal to be noticed this evening belongs to the second order, or vegetable-eating millipedes, and will be called *Sphærotherium novæ-zealandiæ*.

SPHÆROTHERIUM.

The segments resemble those of *Glomeris*, but are fourteen in number, including the head, and twenty-one pairs of legs. Eyes grouped together, and situate on an eminence on each side of the head, just above the insertion of the antennæ.

Sphærotherium novæ-zealandiæ.

Head, coarsely punctured, especially near anterior margin, which is notched in the centre, and strengthened by a ridge, immediately behind which is a transverse groove, and in front a number of yellow and brown hairs; the groove and the space around is closely but coarsely punctured, the punctures becoming much more distant as the posterior margin is approached.

Nuchal Plate.—Anterior margin strengthened by a ridge, produced in the centre, but slightly depressed on superior surface; posterior margin rounded; entire but somewhat irregular.

Dorsal Plates.—Smooth, highly polished. First dorsal segment with a very strong lateral ridge, continued up the anterior margin beyond its articulation with the nuchal plate; in the depression immediately behind the ridge are a number of coarse punctures; a shallow transverse depression about one-third of the distance from anterior margin; the anterior lateral margins very obtusely rounded; the plate produced backwards, so that if the line of junction between the first and second segments was continued, the portion cut off would be nearly semicircular. Last dorsal segment arched, margin entire, sharp, a wide shallow depression immediately inside the margin, expanding upwards at both ends. Intermediate segments smooth above, with the margin rounded in front and pointed behind; strengthened by a ridge, and with a triangular excavation at the anterior angle, most distinct in the fifth and ninth segments; a few yellow hairs in, and a prominent oblong tubercle just above and in front of, each excavation, especially noticeable in fifth to ninth segments. First dorsal segment widest; 2nd to 6th about even; 7th wider; 8th to 11th about even.

Colour.—Light brown, marbled with darker.

Length, 1·35; breadth, ·8; width of head, ·4; depth of head, ·25.

Habitat.—Tinakori Hills, Rimutaka Mountains, Wellington; Stratford, New Plymouth. The specimens from Stratford were presented by Mr. A. Burrell.

No representative of this genus is found in England, but an allied though much smaller form, the common pill-millipede (*Glomeris marginata*), may be seen in almost every English garden; and in old times, both it and the armadillo wood-louse were used in medicine, and may still be found amongst the old stock of some druggists' shops, probably because when rolled up they look like pills—hence the name; and when coated with gum and flour and taken with sufficient faith they were considered very efficacious in various complaints.

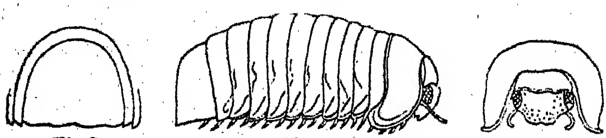


Fig. 3. *Fig.* 1. *Fig.* 2.

1. Profile. 2. Head, nuchal plate, and first segment, front view. 3. Last two dorsal segments from behind.

ART. XXXIII.—*Critical List of the* Crustacea Malacostraca *of New Zealand.* By GEO. M. THOMSON, F.L.S., and CHAS. CHILTON, M.A.*

PART I.

[*Read before the Otago Institute, 10th November,* 1885.]

WITHIN the last few years considerable additions have been made to our knowledge of New Zealand *Crustacea*, especially in the *Amphipoda* and *Isopoda*, and as the literature of the subject has become already somewhat scattered, we have thought it advisable to draw up the following concise list, which we think will prove serviceable to students of Carcinology. The synonymy of most of the species is not given in detail, as such a course would unnecessarily swell out the list, but it is as complete as is needed. The distribution in the colony of each species is given as far as it is known.

It is probable that, as a result of renewed and more detailed examination, some of the species here enumerated will have to be struck out, particularly when more attention has been given to the development and metamorphoses of the individuals, and to the sexual differences. At the same time the number of species yet to be described must be very large. One can hardly make a collection, particularly of *Amphipoda*, in any part of New Zealand, without coming across new and distinct forms; and when more systematic dredging is carried out than has hitherto been attempted, the number of such undescribed forms will be materially increased.

NOTE.—Following Professor von Martens' suggestion, the specific name *neo-zelanicus* has been adopted in place of all the various forms of the word meaning "of" or "from New Zealand."

Crustacea Malacostraca.

Order I.—ARTHROSTACA.

Sub-order I. Amphipoda.

Tribe I. Læmodipoda.

1. CAPRELLINA LONGICOLLIS.

Caprella longicollis. Bate (Cat. Brit. Mus. Amph., p. 362, pl. 57, fig. 4).

Caprellina novæ-zealandiæ, Thomson (Trans. N.Z. Inst., vol. xi., p. 247).

Caprellina longicollis, Mayer (Caprelliden d. Golfes Neapel, p. 27).

Hab. Stewart Island, Dunedin, Oamaru, G.M.T.; Timaru, Lyttelton, C.C. (Chili.)

* While quite prepared to take my full share of responsibility for this paper, I wish to state that the whole work of preparing it has been done by Mr. Thomson. I have simply gone over his manuscript, adding fresh localities, and making a few suggestions and additions here and there.—C. C.

2. CAPRELLA AEQUILIBRA.

Caprella aequilibra, Say (Journ. Acad. Philad. i.). Bate (Cat. Brit. Mus. Amph., p. 362, pl. 57, fig. 5). Mayer (Capr. d. G. Neapel, p. 45).

Caprella caudata, Thomson (Trans. N.Z. Inst., vol. xi., p. 246).

Caprella novæ-zealandiæ, Kirk (Trans. N.Z. Inst., vol. xi., p. 392).

Caprella obesa, Haswell (Cat. Austral. Crust., p. 314).

Hab. Dunedin, Oamaru, G.M.T.; Lyttelton, C.C.; Cook Strait, T. W. Kirk. (N. S. Wales, Japan, China, Brazil, South Carolina, Europe.)

3. CAPRELLA LINEARIS.

Caprella linearis, Bate (Brit. Mus., Cat. Amph., p. 353, pl. 55, fig. 17). Mayer (Capr. d. G. Neapel, p. 58).

Caprella lobata, Kirk (Trans. N.Z. Inst., vol. xi., p. 393).

Hab. Cook Strait, T. W. Kirk. (Europe, East Coast of North America.)

4. CYAMUS CETI.

Cyamus ceti, Martens (Voy. Spitzbergen, 1671), etc., etc. Chilton (Trans. N.Z. Inst., vol. xvi. p. 252).

Hab. Parasitic on whales (*Virgia breviceps*), C.C. It appears to be common on various whales (and sharks ?). I have it from several localities in the New Zealand seas, G.M.T. On small hump-backed whale, Napier, A. Hamilton.

Tribe II. Crevettina.

Fam. I. Corophiidæ.

5. COROPHIUM CONTRACTUM.

Corophium contractum, Stimpson (Proc. Acad. Nat. Sc. Phil., 1855). Bate (Brit. Mus. Cat. Amph., p. 282). Thomson (Ann. and Mag. Nat. Hist., 5, vol. vi., p. 6; Trans. N.Z. Inst., vol. xiii, p. 220, pl. viii).

Hab. Dunedin, G.M.T.; Lyttelton, C.C. (Japan.)

6. COROPHIUM CRASSICORNE.

Corophium crassicorne, Bruzelius (Skand. Amph. Gam., p. 15, pl. i., fig. 2). Bate (Brit. Mus. Cat. Amph., p. 282, pl. 47, fig. 6).

Hab. Lyttelton, C.C. (Norway, Britain.)

[This species is taken along with *C. contractum*, and it is probable that they are only male and female of the same species. *C. Bonnellii* (Milne-Edwards) is probably the same as *C. contractum*.—C.C.]

7. COROPHIUM EXCAVATUM.

Corophium excavatum, Thomson (Trans. N.Z. Inst., vol. xvi., p. 236, pl. 12, figs. 1–8).

Hab. Brighton, near Dunedin, G.M.T.

8. COROPHIUM BARBIMANUM.

Gammarus barbimanus, Thomson (Trans. N.Z. Inst., vol. xi., p. 241).

Corophium lendenfeldi, Chilton (Trans. N.Z. Inst., vol. xvi., p. 262, pl. 20, fig. 1).

Haplocheira typica, Haswell (Proc. Linn. Soc. N.S.W., vol. x., p. 273, p. xi.).

Hab. Dunedin? (specimen in the Otago Museum without locality,) G.M.T.; Lyttelton, C.C. (Sydney, Haswell.)

9. CYRTOPHIUM CRISTATUM.

Cyrtophium cristatum, Thomson (Ann. and Mag. Nat. Hist. 5, vol. iv., p. 331, pl. 16, figs. 9–15).

Hab. Dunedin, G.M.T.; Lyttelton, C.C.

10. PODOCERUS FREQUENS.

Podocerus frequens, Chilton (Trans. N.Z. Inst., xv., p. 85, pl. 3, fig. 2).

Hab. Lyttelton, C.C.

11. PODOCERUS LONGIMANUS.

Podocerus cylindricus, Kirk (Trans. N.Z. Inst., vol. xi., p. 402). Not of Say.

Wyvillea longimanus, Haswell (Proc. Linn. Soc. N.S.W., vol. iv., p. 336, pl. 22, fig. 7).

Podocerus longimanus, Chilton (Trans. N.Z. Inst., vol. xvi., p. 255, pl. 17, fig. 2).

Hab. Lyttelton, C.C.; Wellington, T. W. Kirk. (Port Jackson.)

12. PODOCERUS LATIPES.

Podocerus latipes, Chilton (Trans. N.Z. Inst., vol. xvi, p. 258, pl. 19, fig. 2).

Hab. Lyttelton, C.C.

13. PODOCERUS VALIDUS.

Cyrtophium validum, Dana (U.S. Explor. Exped., p. 841, pl. 56, fig. 2).

Podocerus validus, Bate (Brit. Mus. Cat. Amph., p. 253, pl. 43, fig. 9.) See also N.Z. Journal of Science, vol. i., p. 517.

Hab. Dunedin, G.M.T. Lyttelton, C.C. (Rio Janeiro.)

14. Paranænia typica.

Paranænia typica, Chilton (Trans. N.Z. Inst., vol. xvi., p. 259, pl. 19, fig. 1).

Hab. Lyttelton, C.C.

15. Paranænia dentifera.

Moera dentifera, Haswell (Proc. Linn. Soc., N.S.W., vol. iv., p. 332; pl. 20, fig. 4).

Paranænia dentifera, Chilton (Trans. N.Z. Inst., vol. xvi., p. 260, pl. 21, fig. 2).

Hab. Lyttelton, C.C. (Port Jackson.)

16. Paranænia longimana.

Paranænia longimana, Chilton (Trans. N.Z. Inst., vol. xvi., p. 261, pl. 20, fig. 2).

Hab. Lyttelton, C.C.

17. Iphigenia typica.

Iphigenia typica, Thomson (Trans. N.Z. Inst., vol. xiv., p. 237, pl. 18, fig. 4).

Hab. Dunedin, G.M.T.; Lyttelton, C.C.

Fam. II. Orchestiidæ.

18. Nicea neo-zelanica.

Nicea novæ-zealandiæ, Thomson (Trans. N.Z. Inst., vol. xi., p. 235).

Hab. Along east coast of Otago, G.M.T.

19. Nicea fimbriata.

Nicea fimbriata, Thomson (Trans. N.Z. Inst., vol. xi., p. 236).

Hab. Dunedin, G.M.T.

20. Nicea rubra.

Nicea rubra, Thomson (Trans. N.Z. Inst., vol xi., p. 236).

Hab. Dunedin, G.M.T.; Timaru, Lyttelton, Sumner, C.C.

21. Nicea egregia.

Nicea egregia, Chilton (Trans. N.Z. Inst.).

22. Allorchestes neo-zelanica.

Allorchestes novi-zealandiæ, Dana (U.S. Explor. Exped., p. 894, pl. 61, fig. 1). Bate (Brit. Mus. Cat. Amph., p. 37, pl. 6, fig. 8). Miers (Cat. N.Z. Crust., p. 125).

Hab. Dunedin, Sumner, G.M.T.; Bay of Islands, Dana; Moeraki, T. J. Parker; Lyttelton, C.C.

23. ALLORCHESTES BREVICORNIS.

Allorchestes brevicornis, Dana (U.S. Explor. Exped., p. 893, pl. 60, fig. 8). Bate (Brit. Mus. Cat. Amph., p. 44, pl. 7, fig. 4). Miers (Cat. N.Z. Crust., p. 125).

Hab. Bay of Islands, Dana. [We have not seen this species, G.M.T., C.C.]

24. ALLORCHESTES RECENS.

Allorchestes recens, Thomson (Trans. N.Z. Inst., vol. xvi., p. 235, pl. 13, figs. 2–5).

Hab. Wellington, G.M.T.

25. ORCHESTIA AUCKLANDIÆ.

Orchestia aucklandiæ, Bate (Brit. Mus. Cat Amph., p. 17, pl. 1A, fig. 3). Miers (Cat. N.Z. Crust., p. 121).

Hab. Auckland Island, Stewart Island, G.M.T.; Auckland (Coll. Paris Mus.).

26. ORCHESTIA TELLURIS.

Orchestia telluris, Bate (Brit. Mus. Cat. Amph., p. 20, pl. 3, fig. 6; and pl. 4, fig. 4). Miers (Cat. N.Z. Crust., p. 122).

Hab. Common on sandy shores, from Bay of Islands to Stewart Island, G.M.T.

27. ORCHESTIA CHILENSIS.

Orchestia chilensis, M.-Edw. (Hist. des Crust., t. iii., p. 18). Bate (Brit. Mus. Cat. Amph., p. 30, pl. 1A, fig. 8; and pl. 5, fig. 2). Miers (Cat. N.Z. Crust., p. 123).

Hab. Common on the sea-coast, G.M.T. (Chili.)

28. ORCHESTIA SERRULATA.

Orchestia serrulata, Dana (U.S. Explor. Exped., p. 871, pl. 58, fig. 7). Bate (Brit. Mus. Cat. Amph., p. 31, pl. 5, fig. 4). Miers (Cat. N.Z. Crust., p. 124).

Hab. Bay of Islands, Dana; Stewart Island, G.M.T.

29. ORCHESTIA SYLVICOLA.

Orchestia sylvicola, Dana (U.S. Explor. Exped., p. 874, pl. 59, figs. 2, 3). Bate (Brit. Mus. Cat. Amph., p. 21, pl. 3, fig. 7). Miers (Cat. N.Z. Crust., p. 122). Thomson (Trans. N.Z. Inst., vol. xiii., p. 208).

Orchestia tenuis, Dana (*l.c.*, p. .) Bate, (*l.c.*, p. 29, pl 4, fig. 10).

Orchestia novæ-zealandiæ, Bate (*l.c.*, p. 20, pl. 3, fig. 5).

Hab. Common throughout New Zealand, G.M.T., C.C.

30. TALORCHESTIA TUMIDA.

M.S. species, G. M. Thomson. (N.Z. Journal of Science, vol. ii., p. 577.)

Hab. Purakanui, near Dunedin, G.M.T.

31. Talorchestia quoyana.

♂ *Talorchestia quoyana*, Dana (U.S. Expl. Exped., p. 846). Bate (Brit. Mus. Cat. Amph., p. 16, pl. 2, fig. 7). Miers (Cat. N.Z. Crust., p. 120).

♀ *Orchestia (Talitrus) novi-zealandiæ*, Dana (U.S. Expl. Exped., pl. 56, fig. 5).

♀ *Orchestoidea* (?) *novæ-zealandiæ*, Bate (Brit. Mus. Cat. Amph., p. 10, pl. 1, fig. 2).

♀ *Talitrus* (?) *novæ-zealandiæ*, Miers (Cat. N.Z. Crust., p. 119).

Hab. Common on all sandy shores in New Zealand, G.M.T., C.C.

32. Talitrus brevicornis.

Talitrus brevicornis, M.-Edw. (Hist. d. Crust., vol. iii., p. 15). Dana (U.S. Expl. Exped., pl. 56, fig. 6). Bate (Brit. Mus. Cat. Amph., p. 9, pl. 1A, fig. 6). Miers (Cat. N.Z. Crust., p. 119).

Hab. Bay of Islands, Dana and G.M.T.; Dunedin, G.M.T.

Fam. III. Gammaridæ.

33. Gammarus fragilis.

Gammarus fragilis, Chilton (Trans. N.Z. Inst., vol. xiv., p. 179, pl. 9, figs. 11–18).

Hab. Eyreton and Winchester (in wells), C.C.

34. Megamœra fasciculata.

Megamœra fasciculata, Thomson (Ann. and Mag. Nat. Hist. 5, vol. vi., p. 5, pl. 1, fig. 5).

Hab. Dunedin and Sumner, G.M.T.; Timaru and Lyttelton, C.C.

35. Mœra sub-carinata.

Megamœra sub-carinata, Haswell (Proc. Linn. Soc. N.S.W., vol. iv., p. 335, pl. 21, fig. 4).

Mœra petriei, Thomson (Trans. N.Z. Inst., vol. xiv., p. 236, pl. 18, fig. 3).

Hab. Stewart Island, G.M.T.; Lyttelton, C.C. (Sydney.)

36. Mœra quadrimana.

Gammarus quadrimanus, Dana (U.S. Expl. Exped., p. 955, pl. 65, fig. 9).

Mœra quadrimana, Bate (Brit. Mus. Cat. Amph., p. 194, pl. 35, fig. 5). Thomson (Trans. N.Z. Inst., vol. xiv., p. 235, pl. 17, fig. 4).

Hab. Stewart Island, G.M.T. (Fiji.)

37. MŒRA INCERTA.

Mœra incerta, Chilton (Trans. N.Z. Inst., vol. xv., p. 83, pl. 3, fig. 3).

Hab. Lyttelton, C.C.

38. MŒRA SPINOSA.

Mœra spinosa, Haswell (Proc. Linn. Soc. N.S.W., vol. iv., p. 268, pl. 10, fig. 5). Chilton (Trans. N.Z. Inst., vol. xv., p. 81).

Hab. Auckland, C.C. (Tasmania.)

39. MELITA TENUICORNIS.

Melita tenuicornis, Dana (U.S. Expl. Exped., p. 963). Thomson (Trans. N.Z. Inst., vol. xi., p. 241).

Mœra tenuicornis, Bate (Brit. Mus. Cat. Amph., p. 195, pl. 35, fig. 6).

Paramœra tenuicornis, Miers (Cat. N.Z. Crust., p. 127).

Hab. East Coast of Otago, G.M.T.; Timaru, Lyttelton, C.C.; Bay of Islands, Dana.

40. POLYCHERIA OBTUSA.

Polycheria obtusa, Thomson (Trans. N.Z. Inst., vol. xiv., p. 233, pl. 17, fig. 3).

Hab. Stewart Island, G.M.T.; Lyttelton, C.C.

41. HARMONIA CRASSIPES.

Harmonia crassipes, Haswell (Proc. Linn. Soc. N.S.W., vol. iv., p. 330, pl. 19, fig. 3). Chilton (Trans. N.Z. Inst., vol. xv., p. 82).

Hab. Lyttelton, Timaru, C.C. (Sydney.)

42. CRANGONYX COMPACTUS.

Crangonyx compactus, Chilton (Trans. N.Z. Inst., vol. xiv., p. 177, pl. 10, figs. 13–19).

Hab. Eyreton (in wells), C.C.

43. AORA TYPICA.

♂ *Aora typica*, Kröyer (Tidskr., ser. 2, vol. i., p. 328). Bate (Brit. Mus. Cat. Amph., p. 161, pl. 29, fig. 8).

♀ *Microdeutopus maculatus*, Thomson (Ann. and Mag. Nat. Hist. 5, vol. iv., p. 331, pl. 16, figs 5–8).

♂ *Microdeutopus mortoni*, Haswell (Proc. Linn. Soc. N.S.W., vol. iv., p. 339, pl. 22, fig. 2).

♀ *Microdeutopus tenuipes*, Haswell (*l.c.*, p. 339, pl. 22, fig. 1).

♂ *Microdeutopus maculatus*, Chilton (Trans. N.Z. Inst., vol. xiv., p. 73).

Hab. Dunedin, Stewart Island, G.M.T.; Lyttelton, Sumner, Timaru, Auckland, C.C. (Sydney, Valparaiso.)

44. Leucothoë trailii.

Leucothoë trailii, Thomson (Trans. N.Z. Inst., vol. xiv., p. 234, pl. 18, fig. 1).

Hab. Stewart Island, G.M.T.; Lyttelton, C.C.

45. Seba typica.

Teraticum typicum, Chilton (Trans. N.Z. Inst., vol. xvi., p. 257, pl. 18, fig. 1).

Seba typica, Chilton (N.Z. Journ. Sc., vol. ii, p. 320).

Hab. Lyttelton, C.C.

46. Eusirus cuspidatus, var. antarcticus.

Eusirus cuspidatus, Kröyer (Tidskr. 2, vol. i., p. 501, pl. 7, fig. 1). Bate (Brit. Mus. Cat. Amph., p. 154, pl. 28, figs. 6, 7). Var. *antarcticus*, Thomson (Ann. and Mag. Nat. Hist. 5, vol. vi, p. 4).

Hab. Dunedin, G.M.T. (Greenland.)

47. Amphithonotus levis.

Amphithontus lævis, Thomson (Ann. and Mag. Nat. Hist. 5, vol. iv., p. 330, pl. 16, figs 1 to 4).

Hab. Dunedin, G.M.T.; Timaru, Lyttelton, C.C.

48. Calliopius didactylus.

Calliope didactyla, Thomson (Trans. N.Z. Inst., vol. xi., p. 240).

Hab. East Coast of Otago, G.M.T.

49. Calliopius fluviatilis.

Calliope fluviatilis, Thomson (Trans. N.Z. Inst., vol. xi., p. 240).

Hab. Common in streams, ditches, etc., in Otago, G.M.T.; very common in streams, etc., North Canterbury, C.C.

50. Calliopius subterraneus.

Calliopius subterraneus, Chilton (Trans. N.Z. Inst., vol. xiv., p. 177, pl. 9, figs. 1–10).

Hab. Winchester and Eyreton (in wells), C.C.

51. Pherusa neo-zelanica.

Pherusa novæ-zealandiæ, Thomson (Trans. N.Z. Inst., vol. xi., p. 239).

Hab. Dunedin, G.M.T.

52. Pherusa cœrulea.

Ms. species, G. M. Thomson (N.Z. Journ. of Science, vol. ii., p. 576).

Hab. Stream on the Old Man (Obelisk) Range, Otago, 3,000ft. elevation, G.M.T.

53. ATYLUS DANAI.

Atylus danai, Thomson (Trans. N.Z. Inst., vol. xi., p. 238).

Hab. East coast of Otago, common, G.M.T.; Timaru, Lyttelton, Sumner, C.C.

54. DEXAMINE PACIFICA.

Dexamine pacifica, Thomson (Trans. N.Z. Inst., vol. xi., p. 238).

Hab. Stewart Island, Dunedin, G.M.T.; Lyttelton, C.C.

55. AMPHILOCHUS SQUAMOSUS.

Amphilochus squamosus, Thomson (Ann. and Mag. Nat. Hist., 5, vol. vi., p. 4, pl. 1, fig. 4).

Hab. Dunedin, G.M.T.

56. ŒDICERUS NEO-ZELANICUS.

Œdicerus novæ-zealandiæ, Dana (U.S. Expl. Exped., p. 934, pl. 63, fig. 7). Bate (Brit. Mus. Cat. Amph., p. 104, pl. 17, fig. 1). Miers (Cat. N.Z. Crust., p. 126).

Hab. Bay of Islands, Dana; I do not know this species, G.M.T.; Lyttelton (identification doubtful), C.C.

57. PHOXUS BATEI.

Phoxus batei, Haswell (Proc. Linn. Soc. N.S.W., vol. iv., p. 259, pl. 9, fig. 3). Thomson (Trans. N.Z. Inst., vol. xiv., p. 232, pl. 18, fig, 2).

Hab. Stewart Island, G.M.T. (Sydney.)

58. BIRCENNA FULVA.

Bircenna fulva, Chilton (Trans. N.Z. Inst., vol. xvi., p. 264, pl. 21, fig. 1).

Hab. Lyttelton, C.C.

59. ANONYX EXIGUUS.

Anonyx exiguus, Stimpson (Mar. Invert. Gr. Manan, p. 51). Bate (Brit. Mus. Cat. Amph., p. 75, pl. 12, fig. 3). Thomson (Trans. N.Z. Inst., vol. xiv., p. 232, pl. 18, fig. 2).

Hab. Stewart Island, G.M.T. (E. coast of N. America.)

60. ANONYX CORPULENTUS.

Anonyx corpulentus, Thomson (Trans. N.Z. Inst., vol. xiv., p. 231, pl. 17, fig. 1).

Hab. Stewart Island, G.M.T.

61–63. LYSIANASSA sp.

Lysianassa kröyeri, Bate (Brit. Mus. Cat. Amph., p. 65, pl. 10, fig. 4). Thomson (Trans. N.Z. Inst., vol. xi., p. 237).

The above identification is extremely doubtful; the species referred to it has been found at Dunedin Harbour and Stewart Island, G.M.T. I have at least three species of the genus from

Lyttelton and elsewhere, none of them referable to *L. kröyeri* without considerable doubt, C.C. [Descriptions of these are not published pending the publication of the *Challenger* report on the *Amphipoda.*]

[In the "Zool. Coll. of H.M.S. *Alert*," p. 312, Mr. Miers refers to this genus and species as *Ephippiphora kröyeri* (White), the original designation. Meanwhile the limits of the genus and the characters of the species require complete revision.]

64. Pleustes panoplus.

Pleustes panoplus, Kröyer (Grön. Amf., p. 42). Bate (Brit. Mus. Cat. Amph., p. 63, pl. 9, fig. 9). Kirk (Trans. N.Z. Inst., vol. xi., p. 402).

Hab. Wellington, T. W. Kirk. (Greenland, North Atlantic.)

65. Panoplœa spinosa.

Panoplœa spinosa, Thomson (Ann. and Mag. Nat. Hist., 5, vol. vi., p. 3, pl. 1, fig. 2).

Hab. Dunedin, G.M.T.; Lyttelton, C.C.

66. Panoplœa debilis.

Panoplœa debilis, Thomson (Ann. and Mag. Nat. Hist., 5, vol. p. 3, pl. 1, fig. 3).

Hab. Dunedin, G.M.T.; Lyttelton, C.C.

67. Panoplœa translucens.

Panoplœa translucens, Chilton (Trans. N.Z. Inst., vol. xvi., p. 263, pl. 21, fig. 3).

Hab. Lyttelton, C.C.

68. Cyproidia (?) crassa.

Cyproidia (?) *crassa*, Chilton (Trans. N.Z. Inst., vol. xv., p. 80, pl. 3, fig, 1).

Hab. Lyttelton, C.C. [This species is only placed here provisionally.]

69. Probolium miersii.

Montagua miersii, Haswell (Proc. Linn. Soc. N.S.W., vol. iv., p. 323, pl. 24, fig. 4).

Montaguana miersii, Chilton (Trans. N.Z. Inst., vol. xv., p. 79).

Hab. Timaru, Lyttelton, C.C. (Port Jackson.)

Tribe III. Hyperina.

Fam. I. Phronimidæ.

70. Phronima neo-zelanica.

Phronima novæ-zealandiæ, Powell (Trans. N.Z. Inst., vol. vii., p. 294, pl. 21, fig. 1). Miers (Cat. N.Z. Crust., p. 129).

Hab. Common on East Coast of Otago, G.M.T.; Sumner, Powell; West Coast, Haast; Wellington, Kirk.

71. THEMISTO ANTARCTICA.

Themisto antarctica, Dana (U.S. Expl. Exped., p. 1005, pl. 69, fig. 1). Bate (Brit. Mus. Cat. Amph., p. 312, pl. 50, fig. 8). Thomson (Trans. N.Z. Inst., vol. xi., p. 243).

Hab. East Coast of Otago, G.M.T. (Antarctic Ocean.)

Fam. II. Platyscelidæ.

72. PLATYSCELUS INTERMEDIUS.

Platyscelus intermedius, Thomson (Trans. N.Z. Inst., vol. xi., p. 244).

Hab. East Coast of Otago, G.M.T.

73. OXYCEPHALUS EDWARDSII.

Oxycephalus edwardsii, Thomson (Trans. N.Z. Inst., vol. xvi., p. 238, pl. 12, figs. 14 to 21, and pl. 13, fig. 1).

Hab. East Coast of Otago, G.M.T.

74. PHREATOICUS TYPICUS.

Phreatoicus typicus, Chilton (Trans. N.Z. Inst., vol. xv., p. 89, pl. 4).

Hab. Winchester and Eyreton (in wells), C.C.

[The systematic position of this singular crustacean is doubtful. In general appearance, I was inclined to place it among the *Amphipoda*, but from the fact of the first five pairs of *pleopoda* acting as branchial organs, and from the absence of any such organs attached to the *pereion*, Mr. Chilton places it among the *Isopoda*.—G.M.T.]

Sub-order II.—Isopoda.

Tribe I. Anisopoda.

Fam. 1. Tanaidæ.

75. TANAIS NEO-ZELANICA.

Tanais novæ-zealandiæ, G. M. Thomson (Ann. and Mag. Nat. (Hist., 5, vol. iv., p. 417, pl. 19; Trans. N.Z. Inst., vol. xiii., p. 207, pl. 7).

Hab. Dunedin Harbour, G.M.T.; Lyttelton, C.C.

76. PARATANAIS TENUIS.

Paratanais tenuis, G. M. Thomson (Ann. and Mag. Nat. Hist., 5, vol. vi., p. 2, pl. 1; Trans. N.Z. Inst., vol. xiii., p. 207).

Hab. Dunedin Harbour, G.M.T.; Lyttelton, C.C.

77. APSEUDES TIMARUVIA.

Apseudes timaruvia, Chilton (Trans. N.Z. Inst., vol. xv., p. 146, pl. 18).

Hab. Timaru, C.C.

78. Apseudes latus.

Apseudes latus, Chilton (Trans. N.Z. Inst., vol. xvi., p. 249, pl. 17).

Hab. Lyttelton, C.C.

79. Anthura flagellata.

Anthura flagellata, Chilton (Trans. N.Z. Inst., vol. xiv., p. 172, pl. 8).

Hab. Lyttelton, C.C.

80. Anthura affinis.

Anthura affinis, Chilton (Trans. N.Z. Inst., vol. xv., p. 72, pl. 1).

Hab. Lyttelton, C.C.

81. Paranthura costana.

Anthura gracilis, Milne-Edwards (Hist. des Crust., vol. iii., p. 136, pl. 31).

Paranthura costana, Bate and Westwood (Brit. Sessile-eyed Crust., vol. ii., p. 165). Thomson (Trans. N.Z. Inst., vol. xiv., p. 230).

Hab. Mouth of the Taieri River, G.M.T. (English Channel, Mediterranean.)

82. Cruregens fontanus.

Cruregens fontanus, Chilton (Trans. N.Z. Inst., vol. xiv., p. 175, pl. 10).

Hab. Eyreton and Winchester, Canterbury, in wells, C.C.

Tribe II. Euispoda.

Fam. I. Cymothoidæ.

83. Dynamena huttoni.

Dynamena huttoni, G. M. Thomson (Trans. N.Z. Inst., vol. xi., p. 234).

Hab. Dunedin, G.M.T.; Timaru, Lyttelton Harbour, C.C.

84. Cymodocea cordiforaminalis.

Cymodocea cordiforaminalis, Chilton (Trans. N.Z. Inst., vol. xiv., p. 188, pl. 22).

Hab. Lyttelton, C.C.

85. Cymodocea granulata.

Cymodocea granulata, Miers (Ann. and Mag. Nat. Hist., 4, vol. 17, p. 229; Cat. N.Z. Crust., p. 114, pl. 3, fig. 5).

Hab. New Zealand, Miers; Flinders Island and Tasmania. [We do not know this.—G.M.T., C.C.]

86. CYMODOCEA CONVEXA.

Cymodocea convexa, Miers (Ann. and Mag. Nat. Hist. 4, vol. xvii, p. 229 ; Cat. N.Z. Crust., p. 114, pl. 3, fig. 6).

Hab. New Zealand, Miers. [We do not know this.—G.M.T., C.C.]

87. NÆSA CANALICULATA.

Nesea canaliculata, Thomson (Trans. N.Z. Inst., vol xi., p. 234).

Hab. Dunedin, G.M.T. ; Lyttelton, C.C. [Mr. Miers ("Zool. Coll., H.M.S. *Alert*," p. 309) thinks this belongs to the genus *Cilicæa* of Leach. I cannot set this doubt at rest, as the type appears to have been lost.—G.M.T.]

88. AMPHOROIDEA FALCIFER.

Amphoroidea falcifer, Hutton, M.S. Cat. Thomson (Trans. N.Z. Inst., vol xi., p. 233).

Hab. Dunedin and Stewart Island, G.M.T.; Lyttelton, C.C. (Perhaps this is *A. typica*.—M.-Edwards.)

89. CERATOTHOA IMBRICATA.

Ceratothoa banksii, Miers (Cat. N.Z. Crust., p. 105).

Ceratothoa trigonocephela, Heller (Reise der *Novara*, Crust., p. 148). Thomson (Trans. N.Z. Inst., vol. xi., p. 233).

Ceratothoa imbricata, Miers (Zool. Col. H.M.S. *Alert*, p. 300, where the full synonymy of the species is to be found).

Hab. New Zealand, Miers ; Dunedin, G.M.T. (Australia, India, China.)

90. CERATOTHOA LINEATA.

Ceratothoa lineata, Miers (Ann. and Mag. Nat. Hist. 4, vol. xvii., p. 227 ; Cat. N.Z. Crust., p. 105).

Hab. New Zealand, Miers. [We do not know this species, G.M.T., C.C.]

91. ÆGA NEO-ZELANICA.

Æga novæ-zealandiæ, Dana (U.S. Explor. Exped., p. 767, pl. 51). Miers (Cat. N.Z. Crust., p. 108).

Hab. Bay ot Islands, Dana ; Dunedin and Stewart Island, G.M.T. ; Lyttelton Harbour, C.C. ; Moeraki, T. J. Parker.

92. PSEUDÆGA PUNCTATA.

Pseudæga punctata, G. M. Thomson (Trans. N.Z. Inst., vol. xvi., p. 234, pl. 12).

Hab. Dunedin, G.M.T.

93. Lironeca neo-zelanica.

Lironeca novæ-zealandiæ, Miers (Ann and Mag. of Nat. Hist. 4, vol. xvii., p. 227; Cat. N.Z. Crust., p. 106, pl. 3, fig. 2).

Hab. New Zealand, Miers; Dunedin, G.M.T.; Lyttelton Harbour, C.C.

94. Nerocila macleayii.

Cilonera macleayii, Leach [?] (White in Dieffenb. Voy. N.Z., vol ii., p. 268).

Nerocila imbricata (List Crust. Brit. Mus., p. 108). Miers (Cat. N.Z. Crust., p. 107).

Hab. New Zealand, Fabr. [We do not know this species, G.M.T., C.C.]

95. Cirolana rossii.

Cirolana rossii (List Crust. Brit. Mus., p. 106). Miers (Ann. and Mag. Nat. Hist. 4, vol. xvii., p. 228; Cat. N.Z. Crust., p. 109, pl. 3, fig. 3).

Hab. Auckland Islands, Miers; G.M.T.; Lyttelton Harbour, C.C.

96. Serolis paradoxa.

Serolis paradoxa, And. and M.-Edw. (Archiv. Mus. Hist. Nat., vol. ii., p. 28). Miers (Cat. N.Z. Crust., p. 116, which see for synonymy). Beddard (N.Z. Journ. Sc., vol. ii., p. 390).

Hab. New Zealand ? (Coll. Brit. Mus.). (Patagonia.)

97. Serolis schythei.

Serolis schythei, Lüthen (Naturh. Foren. bidensk, p. 98). Beddard (N.Z. Journ. Sc., vol. ii., p. 390).

Hab. New Zealand ? (Brit. Mus. Coll.) (Patagonia).

98. Serolis bromleyana.

Serolis bromleyana, v. Willemöes-Suhm (Proc. Roy. Soc., vol. xxiv., p. 585). Beddard (N.Z. Journ. Sc., vol. ii., p. 390).

Hab. East of New Zealand; 900 and 1,100 fathoms, Beddard.

99. Serolis latifrons.

Serolis latifrons (List Crust. Brit. Mus., p. 186). Miers (Ann. Mag. Nat. Hist., 4, vol. ., p. 74; Cat. N.Z. Crust., p. 117, pl. 3, fig. 7).

Hab. Auckland Islands (Coll. Brit. Mus.). [We do not know any of the above four species.—G.M.T., C.C.]

100. Scutuloidea maculata.

Scutuloidea maculata, Chilton (Trans. N.Z. Inst., vol. xv., p. 70, pl. 1).

Hab. Lyttelton, Timaru, C.C.

Fam. II. Sphæromidæ.

101. SPHÆROMA GIGAS.

Sphæroma gigas, Leach (Dict. Sci. Nat., vol. xii., p. 346). M.-Edw. (Hist. Nat. Crust., vol. iii., p. 205). Miers (Cat. N.Z. Crust., p. 110).

Hab. Common round the coasts of New Zealand, and at the Auckland Islands, G.M.T., C.C. (Falkland Islands, and Cape Horn.)

102. SPHÆROMA VERRUCAUDA.

Sphæroma verrucauda (List Crust. Brit. Mus., p. 102). Dana (U.S. Explor. Exped., Crust., part ii., p. 779, pl. 53). Miers (Cat. N.Z. Crust., p. 111).

Hab. New Zealand (Coll. Brit. Mus.); Bay of Islands, Dana. (Australia.) [I do not know this species.—G.M.T.]

103. SPHÆROMA OBTUSA.

Sphæroma obtusa, Dana (U.S. Explor. Exped. Crust., part ii., p. 779, pl. 53). Miers (Cat. N.Z. Crust., p. 112).

Hab. Bay of Islands, Dana; G.M.T.; Lyttelton (?), C.C.; Campbell Island, G.M.T.

104. ISOCLADUS ARMATUS.

Sphæroma armata, M.-Edw. (Hist. Nat. Crust., vol. iii., p. 210). White (Dieffenb. New Zeal., vol. ii., p. 268). Dana (U.S. Explor. Exped., Crust., vol. ii., p. 780, pl. 52).

Isocladus armatus, Miers (Cat. N.Z. Crust., p. 112).

Hab. New Zealand (Coll. Mus. Paris); Bay of Islands, Dana; G.M.T.

105. ISOCLADUS SPINIGER.

Sphæroma spinigera, Dana (U.S. Explor. Exped., Crust., vol. ii., p. 780, pl. 52).

Isocladus spiniger, Miers (Cat. N.Z. Crust., p. 113, pl. 3).

Hab. New Zealand (Coll. Brit. Mus.); Bay of Islands, Dana; Lyttelton, C.C. [I do not think I know this form, G.M.T.]

Fam. III. Idoteidæ.

106. IDOTEA MARINA.

Oniscus marinus, Linn. (Fauna Suecica, p. 500), etc.

Idotea marina, Miers (Journ. Linn. Soc., vol. xvi., p. 25; which see for complete synonomy).

Hab. Coast of New Zealand (M. Petit, in Paris Mus. Coll.).

107. IDOTEA METALLICA.

Idotea metallica, Bosc. (Hist. Nat. Crust., vol. ii., p. 179, pl. 15). Miers (Journ. Linn. Soc., vol. xvi., p. 35).

Idotea argentea, Dana (U.S. Explor. Exped. Crust., vol. ii., p. 698, pl. 46). Miers (Cat. N.Z. Crust., p. 92).

Hab. New Zealand (?), Dana.

108. Idotea margaritacea.

Idotea margaritacea, Dana (U.S. Explor. Exped. Crust., vol. ii., p. 700, pl. 46). Miers (Cat. N.Z. Crust., p. 92 ; Journ. Linn. Soc., vol. xvi., p. 38).

Hab. Between Australia and New Zealand, Dana.

[We do not know the preceding three species, G.M.T., C.C.]

109. Idotea lacustris.

Idotea lacustris, G. M. Thomson (Trans. N.Z. Inst., vol. xi., p. 250). Miers (Journ. Linn. Soc., vol. xvi., p. 39).

Hab. Tomahawk lagoon, near Dunedin, Hutton; G.M.T. (Port Henry, Straits of Magellan ?)

110. Idotea ungulata.

Idotea ungulata, Lam. (Hist. Anim. sans Vert., v., p. 160). Miers (Journ. Linn. Soc., vol. xvi., p. 52).

Idotea affinis, M.-Edw. (Hist. Nat. Crust., vol. iii., p. 133). Miers (Cat. N.Z. Crust., p. 93). Thomson (Trans. N.Z. Inst., vol. xi., p. 232).

Hab. Common round the coasts of New Zealand, G.M.T., C.C.

111. Idotea elongata.

Idotea elongata (List Crust. Brit. Mus., p. 95). Miers (Ann. Mag. Nat. Hist., 4, vol. xvii., p. 225 ; Cat. N.Z. Crust., p. 93, pl. 2 ; Journ. Linn. Soc., vol. xvi., p. 54).

Hab. Auckland Islands (Coll. Brit. Mus.) ; Auckland (Coll. Paris Mus.) ; Lyttelton, C.C. ; Akaroa, R. M. Laing.

112. Idotea festiva.

Idotea festiva, Chilton (N.Z. Journ. of Science, vol. ii., p. 320 ; Ann. Mag. Nat. Hist., 5, vol. , p. 123, pl. 5A., figs. 1 to 3.

Hab. Sumner, near Christchurch, C.C.

113. Edotia dilatata.

Edotia dilatata, G. M. Thomson (Trans. N.Z. Inst., vol. xvi., p. 235, pl. 12).

Hab. Auckland, T. F. Cheeseman.

114. Cleantis tubicola.

Cleantis tubicola, Thomson (N.Z. Journ. of Science, vol. ii., p.).

Hab. Auckland, R. Gillies.

115. Arcturus tuberculatus.

Arcturus tuberculatus, Thomson (Ann. Mag. Nat. Hist., 5, vol. iv., p. 416, pl. 19 ; Trans. N.Z. Inst., vol. xiii., p. 206, pl. 7).

Hab. Dunedin Harbour, G.M.T. ; Lyttelton Harbour, C.C.

Fam. IV. Aselidæ.

116. JÆRA NEO-ZELANICA.

Jæra novæ-zealandiæ, Chilton (Trans. N.Z. Inst., vol. xv., p. 189).

Hab. Lyttelton, C.C.

117. LIMNORIA SEGNIS.

Limnoria segnis, Chilton (Trans. N.Z. Inst., vol. xv., p. 76, pl. 2).

Hab. Lyttelton, C.C.

118. JANIRA LONGICAUDA.

Janira longicauda, Chilton (Trans. N.Z. Inst., vol. xvi., p. 250, pl. 18).

Hab. Lyttelton, C.C.

119. STENETRIUM FRACTUM.

Stenetrium fractum, Chilton (Trans. N.Z. Inst., vol. xvi., p. 251, pl. 18).

Hab. Lyttelton, C.C.

Fam. V. Oniscidæ.

120. LIGIA NEO-ZELANICA.

Ligia novæ-zealandiæ, Dana (U.S.Explor. Exped., Crust., vol. ii., p. 739, pl. 49). Miers (Cat. N.Z. Crust., p. 103).

Hab. Bay of Islands, Dana. [I do not know this species, G.M.T.]

121. LIGIA QUADRATA.

Ligia quadrata, Hutton (M.S. Cat. N.Z. Crust.). Thomson (Trans. N.Z. Inst., vol. xi., p. 232).

Hab. Bay of Islands, Waiwera, Dunedin, Stewart Island, G.M.T.; Lyttelton, Sumner, C.C.

122. PHILYGRIA ROSEA.

Itea rosea, Koch (Contin. Panzer Deutsch. Ins., 162, 16; Deutsch. Crust., 22, 16).

Philougria rosea, Kinahan (Nat. Hist. Rev., vol. v., p. 197, pl. 23). Bate and Westwood (Brit. Sess.-eyed Crust., vol. ii., p. 460). Chilton (Trans. N.Z. Inst., vol. xv., p. 73).

Hab. Canterbury generally, and Lake Wakatipu, C.C.; Nelson (in a cave), J. C. Gully. (Britain, Germany.)

123. PHILYGRIA THOMSONII.

Philougria thomsoni, Chilton (N.Z. Jour. Sci., vol. ii., p.).

Hab. Spar Bush, Southland, C.C.

124. Oniscus punctatus.

Oniscus punctatus, Thomson (Trans. N.Z. Inst., vol. xi., p. 232).

Hab. Common from Auckland to Stewart Island, G.M.T., C.C.

125. Oniscus pubescens.

Oniscus pubescens, Dana (U.S. Explor. Exped. Crust., vol. ii., p. 730, pl. 48). Miers (Cat. N.Z. Crust., p. 99).

Hab. Whaikare River, Dana. [I do not know this species.—G.M.T.]

126. Porcellio graniger.

Porcellio graniger (List Crust. Brit. Mus., p. 99). Miers (Ann. Mag. Nat. Hist., 4, vol. xvii., p. 226; Cat. N.Z. Crust., p. 99).

Hab. Common everywhere in New Zealand, G.M.T., C.C.

127. Porcellio neo-zelanicus.

Porcellio zealandicus (List Crust. Brit. Mus., p. 99). Miers (Ann. Mag. Nat. Hist., 4, vol. xvii., p. 225; Cat. N.Z. Crust., p. 100, pl. 2).

Hab. New Zealand (Coll. Brit. Mus.). [We do not know this species.—G.M.T., C.C.]

128. Scyphax ornatus.

Scyphax ornatus, Dana (U.S. Explor. Exped., Crust., vol. ii., p. 734, pl. 48). Miers (Cat. N.Z. Crust., p. 101).

Hab. Bay of Islands, Dana.

129. Scyphax intermedius.

Scyphax intermedius, Miers (Ann. Mag. Nat. Hist., 4, vol. xvii., p. 227; Cat. N.Z. Crust., p. 102, pl. 2).

Hab. New Zealand (Coll. Brit. Mus.). [We do not know the two foregoing species.—G.M.T., C.C.]

130. Actæcia euchroa.

Actæcia euchroa, Dana (U.S. Explor. Exped., Crust., vol. ii., p. 734 ?). Miers (Cat. N.Z. Crust., p. 102). Thomson (Trans. N.Z. Inst., vol. xi., p. 249).

Hab. Bay of Islands, Dana, G.M.T.; Dunedin, G.M.T.

131. Actæcia aucklandiæ.

Actæcia aucklandiæ, Thomson (Trans. N.Z. Inst., vol. xi., p. 249).

Hab. Auckland Islands, Jennings.

132. Cubaris rugulosus.

Cubaris rugulosus, Miers (Ann. and Mag. Nat. Hist., 4, vol. xvii., p. 225; Cat. N.Z. Crust, p. 96, pl. 2). Chilton (Trans. N.Z. Inst., vol. xv., p. 73).

Hab. New Zealand (Coll. Brit. Mus.); Dunedin, G.M.T.; Canterbury and Southland, C.C.

133. SPHERILLO MONOLINUS.

Spherillo monolinus, Dana (U.S. Explor. Exped., Crust., vol. ii., p. 719, pl. 47). Miers (Cat. N.Z. Crust., p. 97).

Hab. Auckland, Heller; Waikare River (Coll. Dr. C. Pickering, Dana). [I do not know this species.—G.M.T.]

134. SPHERILLO SPINOSUS.

Spherillo spinosus, Dana (U.S. Explor. Exped. Crust., vol. ii., p. 723, pl. 47). Miers (Cat. N.Z. Crust., p. 97).

Hab. Near Bay of Islands (Coll. Dr. C. Pickering, Dana); Dunedin (?), G.M.T.

135. SPHERILLO DANÆ.

Spherillo danæ, Heller (Voy. *Novara*, Crust., p. 134, pl. 12). Miers (Cat. N.Z. Crust., p. 97).

Hab. Auckland, Heller. [I do not know this species.—G.M.T.]

136. ARMADILLO SPECIOSUS.

Armadillo speciosus, Dana (U.S. Explor. Exped., Crust., vol. ii., p. 718, pl. 47). Miers (Cat. N.Z. Crust., p. 95).

Hab. Bay of Islands, Dana; Wellington, Hutton; Nelson, J. C. Gully.

137. ARMADILLO INCONSPICUUS.

Armadillo inconspicuus, Miers (Ann. and Mag. Nat. Hist., 4, vol. xvii., p. 225; Cat. N.Z. Crust., p. 95, pl. 2).

Hab. New Zealand (Coll. Brit. Mus). [I do not know this species.—G.M.T.]

Gen. et sp. incertæ sedis.

138. PLAKARTHRIUM TYPICUM.

Plakarthrium typicum, Chilton (Trans. N.Z. Inst., vol. xv., p. 74, pl. 1).

Hab. Lyttelton, C.C.

ART. XXXIV.—*A New Species of* Philygria.*

By CHAS. CHILTON, M.A.

[*Read before the Philosophical Society of Canterbury, 26th November*, 1885.]

Plate V.

PHILYGRIA THOMSONI, sp. nov. Plate V., figs. 1 to 6.

BODY, fairly convex; length, about twice the greatest breadth; first segment of thorax produced anteriorly on each side into rounded lobes, so as to enclose about half of the head, which is

* From a remark in the "Zoological Record" for 1877, Crust., p. 24, it appears that *Philygria* is a more correct spelling of the word than *Philougria*.

small and transversely elliptical, and is produced below and in front of the eyes into small rounded projections. Last six segments of thorax of about equal lengths, and shorter than the first; last three with the postero-lateral angles acute, produced. Abdomen much narrower than the thorax, and narrowing considerably posteriorly; lateral margins nearly straight; last segment subtriangular, with apex truncate; posterior margin, and the posterior portions of the lateral margins, perfectly straight. Surface smooth and shining, apparently with very short setæ at intervals. Colour, mostly black, or very dark brown, with markings of light yellow or white.

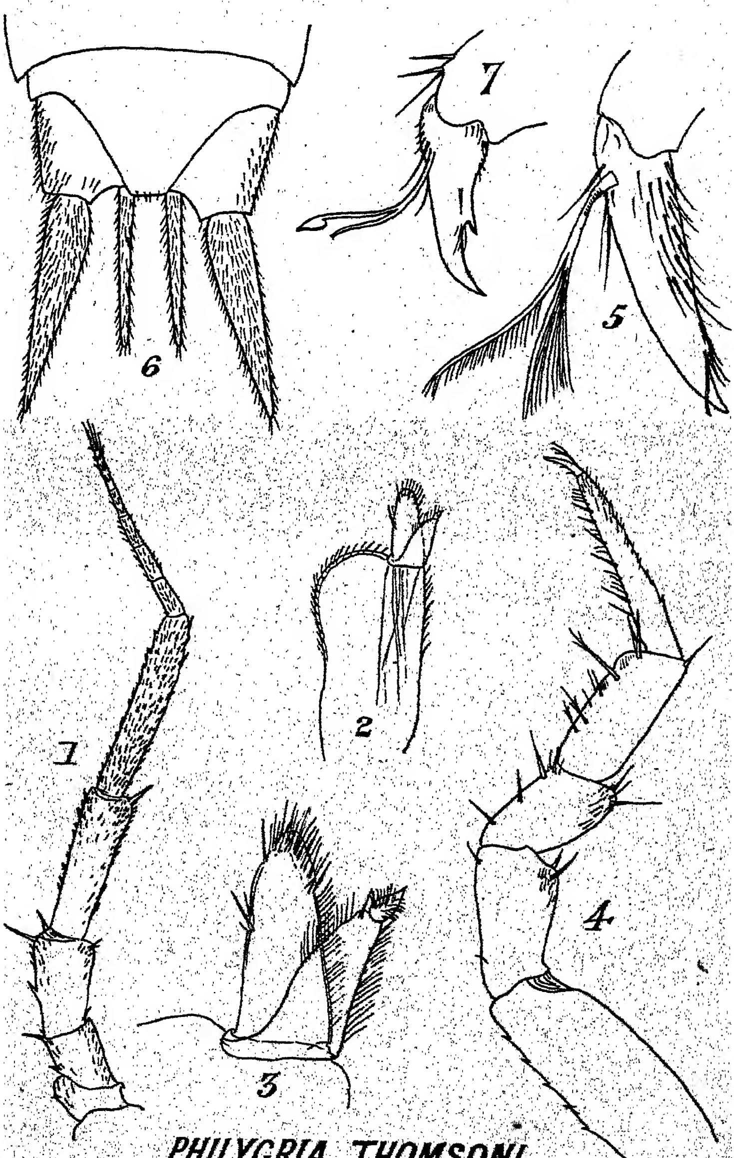
Inner antenna small, but able to be seen in dorsal view. Outer antenna, with the first three joints increasing in length; third, as long as the first and second together; fourth, half as long again as the third, and about three-fourths as long as the fifth. Third stouter than the fourth, which is stouter than the fifth. Flagellum as long as the fifth joint, and tapering gradually; clearly divided into five joints, and the last, which is longer than any of the others, bears indistinct marks as if divided into two, the extremity bearing a pencil of straight setæ. Whole antenna, thickly covered with very fine setæ, and having larger setæ at the distal ends of the second, third, and fourth joints. Thoracic legs, increasing considerably in length posteriorly, bearing many long, stiff setæ, particularly on the carpus, near the distal end of which the longest is situated. Dactylos bearing a peculiar seta longer than the dactylos itself; it is stout at base, and soon splits up into two branches of about equal size; the branch remote from the dactylos giving off numerous sub-branches on the side near the dactylos; the other branch splitting into several branches, which still further subdivide towards the end. Posterior pleopoda rather large, two-thirds as long as the abdomen; inner ramus articulated to the inner margin of the peduncle anteriorly to the outer ramus, slender, and about three-fourths as long as outer ramus, which narrows rapidly towards the extremity; both bear a few setæ at the end, and are thickly covered with very short setæ.

Length: ·3 inch.

Hab.—Spar bush, Southland.

I have named this species after Mr. G. M. Thomson, from whom I have received much kind assistance.

In general appearance, and in the form of the outer antenna, it differs considerably from the species common in many parts of the South Island, which I have previously identified with *Philygria rosea*, and it is much larger than the ordinary specimens of this species; though I have one specimen of *P. rosea* from Kinloch, Lake Wakatipu, quite as large as any of my specimens of *P. thomsoni*. In some details, however, I find the two are strikingly alike. This is particularly the case with the



PHILYGRIA THOMSONI.

maxillipedes and the peculiar setæ on the dactylos of each of the thoracic legs. In *P. thomsoni*, in the maxilipedes (see fig. 2), there is a large basal joint, which bears at its extremity two small, but well-marked branches. The inner branch consists of two joints; the first much the larger of the two, narrowing distally, and having both margins fringed with fine straight setæ, the outer margin being slightly crenate towards the distal end. The second joint is conical in shape, and bears many curved setæ projecting radically around the joint. The outer branch is slightly longer than the inner, and consists of a single joint, which narrows distally and is rounded at the end, the inner margin fringed with fine straight setæ, and the rounded end thickly supplied with stouter stiff setæ which vary considerably in thickness, one of the stoutest being situated on the outer margin, slightly removed from the others; and more proximally at the centre of the outer margin is another one equally stout, with one or two more delicate setæ alongside it. The description here given would apply almost equally well to the maxillipede of *P. rosea*, but, as the specimens of that species are smaller, the various details are not so distinctly marked.

The form of the pecular seta arising from the dactylos of each of the thoracic legs, will be readily understood from the description already given, and from the drawing of it in fig. 5. The one found in *P. rosea* is practically identical in form. In *P. marina*, Coogee Bay, Sydney, there is a seta found in the same position, but it is of quite a different form; I give a drawing (fig. 7) for the sake of comparison. The other setæ on the legs of *P. thomsoni* generally show a transverse division in the centre, and are split towards the end; but the parts lie close together, and are often difficult to see.

DESCRIPTION OF PLATE V.

PHILYGRIA THOMSONI.—*Figs.* 1 *to* 6.

Fig. 1. Outer antenna × 30.
Fig. 2. Maxillipede × 39.
Fig. 3. End of same × 120.
Fig. 4. Seventh thoracic leg × 30.
Fig. 5. Dactylos of same × 233.
Fig. 6. Extremity of abdomen × 30.

PHILYGRIA MARINA.—*Fig.* 7.

Fig. 7. Dactylos of thoracic leg × 233.

Art. XXXV.—*Description of New Zealand* Micro-Lepidoptera.

By E. Meyrick, B.A.

[*Read before the Canterbury Philosophical Institute, 1st October, 1885.*]

VIII. TINEINA (Part).

The New Zealand species of four families—the *Gelechiadæ*, *Depressariadæ*, *Plutellidæ*, and *Micropterygidæ*—are here described, together with an additional species of *Gracilariadæ*. All these are scantily represented, and, though they will doubtless be materially increased, are never likely to occupy any conspicuous place in the fauna; but the *Micropterygidæ* are of very great interest. Remarks on these will be found under their individual heads.

GELECHIADÆ.

Head smooth. Antennæ in male usually simple, sometimes ciliated. Labial palpi recurved, pointed. Maxillary palpi very short, not developed. Forewings with vein 1 furcate at base, 7 and 8 stalked (rarely coincident), 7 usually to costa, all veins normally present. Hindwings more or less trapezoidal, hind-margin often indented, veins 3 and 4 separate or from a point, 6 and 7 stalked or approximated at base, rarely remote.

This family occupies a less prominent place in New Zealand than it usually does elsewhere. The only genus fairly represented is *Gelechia*, which is probably cosmopolitan. *Megacraspedus*, of which there is one species, occurs in Australia and Europe; doubtless also in intermediate regions. *Scieropepla* is an Australian genus; the single New Zealand species is also Australian, and has probably immigrated in recent times. The other three genera are endemic, so far as known.

1a. Second joint of palpi tufted beneath.	
2a. Veins 3 and 4 of hindwings stalked	5. *Anisoplaca*
2b. ,, ,, ,, ,, remote	1. *Megacraspedus*
1b. Second joint of palpi not tufted beneath.	
2a. Veins 2 and 8 of forewings absent	3. *Thiotricha*
2b. ,, ,, ,, ,, present.	
3a. Vein 6 of forewings out of 7	2. *Isochasta*
3b. ,, ,, ,, separate.	
4a. Antennæ of male ciliated	4. *Scieropepla*
4b. ,, ,, not ciliated	5. *Gelechia*.

1. Megacraspedus, Z.

Head smooth; ocelli present; tongue well developed. Antennæ $\frac{4}{5}$ of forewings, in male ciliated (1), joints angularly projecting, basal joint long, slender, terminally dilated, without pecten. Labial palpi long, recurved, second joint densely scaled, with a long projecting dense apical tuft beneath; terminal joint as long as second, slender, acute. Maxillary palpi very short, appressed to tongue. Posterior tibiæ thinly clothed with hairs

above. Forewings with vein 1 furcate, 2 from $\frac{1}{2}-\frac{3}{4}$ of cell, 6 separate or out of stalk of 7 and 8, 7 and 8 stalked, 7 to costa, 11 from or before middle of cell. Hindwings as broad as forewings, trapezoidal, apex long, acute, projecting, hind-margin deeply sinuate-emarginate, cilia $2\frac{1}{2}-3$; veins 3 and 4 remote at origin, transverse vein bent outwards, 5 and 6 from rather near together, 7 remote from 6.

The genus may be regarded as consisting of two sections; A., in which vein 6 of the forewings rises out of 7, as in the European *M. binotellus* (F.R.); and B., in which vein 6 of the forewings is separate from 7, as in the European *M. imparellus* (F.R.); it is to section B. that the New Zealand and Australian species all belong.

1. *Meg. calamogonus*, n. sp.

Female.—10–16 mm. Head, palpi, antennæ, and thorax whitish-ochreous. Abdomen and legs grey-whitish, anterior tibiæ and tarsi banded with dark fuscous. Forewings elongate, narrow, very acutely pointed; whitish-ochreous, veins sometimes slightly infuscated; a dark fuscous dot in disc slightly before middle, a second very obliquely before it on fold, and a third in disc at $\frac{2}{3}$; a short fuscous apical streak: cilia ochreous-whitish. Hindwings and cilia whitish.

Larva undescribed, feeding in the seed-heads of *Arundo conspicua;* pupa in a slight cocoon in the same position.

Christchurch; three specimens, in August, November, and March. Several were bred from the larvæ in November by Mr. R. W. Fereday.

2. Isochasta, n. g.

Head smooth; ocelli present; tongue well-developed. Antennæ $\frac{4}{5}$ of forewings, in male serrate, shortly ciliated (1), basal joint elongate, without pecten. Labial palpi moderately long, recurved, second joint thickened with appressed scales, rough beneath, terminal joint somewhat shorter than second, moderate, acute. Maxillary palpi very short, appressed to tongue. Posterior tibiæ clothed with long fine hairs above. Forewings with vein 1 furcate, 2 from $\frac{2}{3}$ of cell, 6 and 7 stalked out of 8, 7 to costa, 11 from before middle of cell. Hindwings as broad as forewings, trapezoidal, apex acute, projecting, hindmargin angularly emarginate, cilia $1\frac{1}{2}$; veins 3 and 4 remote, 5 nearer 6 than 4, 6 and 7 remote.

2. *Isoch. paradesma*, n. sp.

Male.—17 mm. Head and thorax grey-whitish, crown and a spot on shoulders grey. Palpi with second joint dark fuscous, terminal joint white, with a dark fuscous band above middle. Antennæ dark grey. Abdomen grey, and tuft whitish. Legs blackish, with whitish rings at apex of joints, posterior tibiæ whitish. Forewings narrow-lanceolate; whitish, irregularly

irrorated with light grey; a grey suffusion along inner margin from base to anal angle; a small blackish spot on costa almost at base; a black dot beneath costa at $\frac{1}{5}$, and a second larger one beneath it on fold; a thick blackish transverse somewhat oblique streak at $\frac{1}{3}$, reaching from beneath costa to fold, margins irregular; two black dots nearly longitudinally placed in middle of disc, and a third in disc at $\frac{3}{4}$: cilia grey-whitish, with a cloudy blackish-grey line near base round apex and upper part of hindmargin, interrupted into spots. Hindwings grey; cilia grey-whitish.

Invercargill; one specimen in December.

3. Thiotricha, n. g.

Head smooth; ocelli present; tongue well-developed. Antennæ $\frac{3}{4}$ of forewings, in male serrate, clothed with extremely long fine cilia (5–6), basal joint elongate, without pecten. Labial palpi moderately long, smoothly scaled, recurved, second joint hardly thickened or somewhat rough beneath, terminal joint as long as second, acute. Maxillary palpi obsolete. Posterior tibiæ clothed with long hairs above. Forewings with vein 1 furcate, 2 absent (coincident with 3), 3, 4, 5 approximated, 6 rising out of 7 or separate, 7 to costa, 8 absent (coincident with 7), 9 and 10 more or less approximated to 7 at base, 11 from beyond middle of cell. Hindwings as broad as forewings, trapezoidal, apex tolerably acute, hindmargin somewhat sinuate, cilia $1\frac{1}{2}$; vein 2 widely remote from 3, 3 and 4 from a point, 5 bent, 6 and 7 stalked.

Sharply characterised by the extraordinarily developed ciliations of the antennæ of male (which are unique in this family), and the absence of veins 2 and 8 of the forewings.

Sect. A.—Vein 6 of forewings separate from 7.

3. *Thiotr. tetraphala*, n. sp.

Male.—12 mm. Head, palpi, antennæ, thorax, abdomen, and legs whitish-grey, somewhat shining; second joint of palpi dark grey; anterior legs dark grey. Forewings elongate, narrow, acutely pointed; light grey, somewhat irrorated with grey-whitish in disc; three dark grey spots; first basal; second triangular, in disc before middle; third larger, oblong, beyond middle, resting on submedian fold: cilia grey-whitish, with a suffused interrupted grey line near base round apex. Hindwings grey; cilia whitish-grey.

Dunedin; one specimen in February.

Sect. B.—Vein 6 of forewings rising out of 7.

4. *Thiotr. thorybodes*, n. sp.

Male, female.—11–13 mm. Head, palpi, antennæ, thorax, and abdomen whitish-ochreous; second joint of palpi dark

fuscous. Legs dark fuscous, posterior tibiæ and apex of joints whitish-ochreous. Forewings elongate, narrow, round-pointed; rather dark fuscous, irregularly irrorated with ochreous-whitish, more strongly in disc; costa suffusedly darker, and with a darker triangular patch before middle, its apex reaching to fold; an obscure dark fuscous dot in disc slightly beyond middle; a small whitish-ochreous spot, sometimes nearly obsolete, in disc at $\frac{3}{4}$: cilia grey-whitish, with a dark fuscous line near base. Hindwings grey-whitish or whitish-grey; cilia grey-whitish.

Christchurch; five specimens taken amongst forest-growth in January and February.

4. Scieropepla, n. g.

Head smooth; no ocelli; tongue well-developed. Antennæ $\frac{2}{3}$, in male shortly ciliated (1), with angularly projecting joints, basal joint moderately elongate, without pecten. Labial palpi moderately long, recurved, smoothly scaled, second joint somewhat thickened terminally, terminal joint rather shorter than second, acute. Maxillary palpi short, appressed to tongue. Posterior tibiæ clothed with dense long hairs above. Forewings with vein 1 furcate, upper fork partially obsolete, 2 from $\frac{4}{5}$ of cell, 3 and 4 approximated at base, 7 and 8 stalked, 7 to costa, 11 from middle of cell. Hindwings as broad as forewings, tolerably trapezoidal, apex round-pointed, hindmargin hardly sinuate, cilia $\frac{2}{3}$; 3 and 4 short-stalked, 5 from nearer 4 than 6, 6 and 7 stalked.

An early type, represented by several species in Australia. The larvæ of two are known, both feeding in seed-heads.

5. *Scier. typhicola*, n. sp.

Male, female.—17–19 mm. Head, palpi, antennæ, thorax, abdomen, and legs pale whitish-ochreous, centre of thorax often fuscous; tarsi, and second joint of palpi towards apex, infuscated. Forewings elongate, acutely pointed; whitish-ochreous, sometimes thinly irrorated with brownish-ochreous, costa paler: cilia whitish-ochreous. Hindwings grey-whitish; cilia ochreous-whitish.

Larva 16-legged, stout, cylindrical; whitish, sometimes slightly suffused with pale flesh-colour; dorsal slender, dark flesh-colour; subdorsal and spiracular lines broader, indistinct, flesh-colour; head pale amber, mouth fuscous; second segment with a faint pale amber shield, black-margined on sides; anal segment speckled with black. Feeds in seed-heads of *Typha angustifolia*, burrowing amongst the seeds and causing the down to hang out in large loose masses; sometimes also boring down stems, eating the pith and making many small holes in the sides; found throughout June.

Christchurch; also occurs in New South Wales; bred freely in June, July, and August, but rarely seen at large. The species must be regarded as an immigrant from Australia.

5. GELECHIA, Z.

Head smooth; ocelli present; tongue well-developed. Antennæ $\frac{2}{3}$ of forewings, in male filiform, simple or pubescent, basal joint moderately elongate, without pecten. Labial palpi moderately long, recurved, second joint thickened with appressed scales, rough beneath, terminal joint as long or nearly as long as second, moderately slender, acute. Maxillary palpi short, appressed to tongue. Posterior tibiæ clothed with hairs above. Forewings with vein 1 furcate, 2 from about $\frac{3}{4}$ of cell, 7 and 8 stalked, 7 to costa, 11 from about middle of cell. Hindwings as broad as forewings or rather broader, trapezoidal, apex pointed or round-pointed, hindmargin shallowly emarginate or hardly perceptibly sinuate, cilia $\frac{2}{3}$–$1\frac{1}{2}$; veins 3 and 4 from a point, 5 from rather near 4, 6 and 7 from a point or approximated towards base.

The variation in the form of hindwings and length of cilia is used by Heinemann to characterise two groups, *Gelechia* and *Lita*, as separate genera; but these shade so imperceptibly into each other, that I am of opinion that the distinction cannot be advantageously maintained: most of the following species are of an intermediate character, and might be ranked almost equally well with either group. As thus limited, the genus is very large, especially predominating in Europe and North America.

1a. Hindwings in male with a costal pencil of long hairs — 6. *solanella.*
1b. „ „ without costal pencil.
  2a. Discal spots surrounded with pale rings .. .. 14. *achyrota.*
  2b. „ not ringed.
    3a. Thorax partially dark fuscous.
      4a. Dark costal area of forewings continued evenly to apex .. 10. *parapleura.*
      4b. „ „ „ terminating about $\frac{3}{4}$ .. 8. *brontophora.*
    3b. Thorax not dark fuscous.
      4a. Palpi with four blackish bands .. .. 7. *thyraula.*
      4b. „ without distinct blackish bands.
        5a. Head and thorax grey .. .. .. 13. *lithodes.*
        5b. „ „ whitish-ochreous.
          6a. Hindwings with a cloudy fuscous streak in disc .. .. 9. *schematica.*
          6b. „ without discal streak.
            7a. Forewings with a mostly entire dark median streak .. 12. *monophragma.*
            7b. „ with at most an apical streak.. .. .. 11. *pharetria.*

6. *Gel. solanella*, Boisd.

(*Bryotropha solanella*, Boisd., J. B. Soc. Centr. Hort., 1874; Ragonot, Bull. Soc. Ent. Fr., 5 (v.), pp. xxxv.-xxxvii.; Meyr., Proc. Linn. Soc. N.S.W., 1879, 112; *Gelechia terrella*, Walk., 1024.)

Male, female.—14–16 mm. Head, palpi, and thorax pale brownish-ochreous, irrorated with grey-whitish; palpi with two

dark fuscous bands on second joint, and one above middle on terminal joint. Antennæ, abdomen, and legs pale greyish-ochreous, legs irrorated with dark fuscous. Forewings elongate, narrow, acutely pointed; pale brownish-ochreous, densely irrorated with whitish-grey, and more or less with dark grey or blackish-grey; the dark irroration forms two small spots on costa towards base, and a suffused streak along inner margin, connected with three or four small irregular spots about fold; cilia pale greyish-ochreous, towards base mixed with blackish-grey points, forming one or two distinct blackish lines round apex. Hindwings with apex acute, hindmargin moderately emarginate, in male with a dilation in middle of costa, and a long dense pencil of hairs from costa at base; pale grey; cilia pale greyish-ochreous.

Closely allied to the other European species of the *Solanum*-feeding group, but distinguished from all by the costal hair-pencil of the hindwings in male.

Larva feeding gregariously in the tubers of the cultivated potato, boring galleries through their substance, and causing them to rot. This insect does very great damage, especially where potatoes are allowed to remain stored for any length of time, and sometimes destroys nine-tenths of the crop.

Taranaki and Napier, probably generally distributed; common also throughout Eastern Australia; occurs from November to May, coming freely to lamps, and flying at dusk in potato-fields. The species has certainly been introduced with the potato, and is probably a native of Algeria.

Walker's name is really the older, but cannot be allowed to stand, as he appears to have overlooked the already existing *Gelechia terrella*, Hb., a well-known and abundant European species.

7. *Gel. thyraula*, n. sp.

Male.—9–11 mm. Head, palpi, thorax, and abdomen white irrorated with grey; palpi with two blackish bands on each joint. Antennæ white, annulated with black. Legs blackish, apex of joints and a median ring of tibiæ white. Forewings elongate, narrow, acutely pointed; whitish, irrorated with black; markings black, ill-defined; a small spot on costa near base, and a second obliquely beyond it on fold; a rather oblique streak from costa beyond $\frac{1}{4}$, reaching half across wing; three small discal spots, first in middle, second on fold obliquely before first and almost touching apex of transverse streak, third in disc beyond middle; cilia grey-whitish, towards base mixed with black points. Hindwings with apex acute, hindmargin moderately emarginate; pale whitish-grey; cilia grey-whitish.

An inconspicuous but easily recognised species.

Christchurch and Castle Hill; five specimens in January and February.

8. *Gel. brontophora*, n. sp.

Male.—11 mm. Head and palpi whitish-ochreous; palpi with two blackish bands on each joint. Antennæ dark fuscous, spotted with whitish-ochreous. Thorax blackish fuscous, with a whitish-ochreous anterior central spot. Abdomen whitish-grey. Legs blackish, apex of joints and middle ring of tibiæ ochreous-whitish. Forewings elongate, narrow, acutely pointed; whitish-ochreous, thinly irrorated with brownish-ochreous; a dense black irroration covering costal half of wing to fold from base to middle, except an oblique irregular bar at $\frac{1}{4}$, posteriorly suffusedly attenuated to costa at $\frac{3}{4}$; five irregular black discal spots, first in middle, second obliquely before first on fold, confluent with costal irroration, third below first, connected with it by a cloudy black irroration, fourth larger, in disc at $\frac{2}{3}$, fifth beyond fourth: cilia pale whitish-ochreous, with scattered black points towards base. Hindwings with apex acute, hindmargin moderately sinuate; whitish-grey; cilia grey-whitish.

Christchurch; one specimen in February.

9. *Gel. schematica*, n. sp.

Male.—16–17 mm. Head and palpi whitish-ochreous. Antennæ fuscous. Thorax whitish-ochreous, more or less infuscated. Abdomen ochreous-whitish, basal half light ochreous above. Legs ochreous-whitish, anterior and middle pair suffused with fuscous. Forewings elongate, narrow, acutely pointed; light greyish-ochreous towards disc, sometimes irrorated with deep ochreous; a dark grey or blackish irroration forming a broad suffused streak along costa from base to $\frac{2}{3}$, posteriorly attenuated, variable in intensity, generally divided by a cloudy oblique streak of ground-colour from base to middle of costa; three small dark fuscous discal spots, first before middle, second on fold obliquely before first, third in disc at $\frac{3}{5}$: cilia ochreous-whitish, with two irregular interrupted lines of blackish points. Hindwings with apex tolerably acute, hindmargin moderately sinuate; whitish-grey, with a cloudy longitudinal streak of dark fuscous scales in disc towards base; cilia ochreous-whitish.

This and the three following species are nearly allied; this species is recognisable by the greyer tinge and dark costal suffusion of the forewings, and especially the dark discal streak of hindwings (though this may possibly not persist in the female).

Castle Hill and Bealey River (2,100–2,500 feet); five specimens in January.

10. *Gel. parapleura*, n. sp.

Male, female.—16 mm. Head and palpi ochreous-white, apex of palpi black. Antennæ dark fuscous. Thorax dark

purplish-fuscous, with a broad central ochreous-white stripe. Abdomen ochreous-whitish. Legs dark fuscous, apex of joints and posterior pair ochreous-whitish. Forewings elongate, narrow, acutely pointed; dark fuscous; a broad pale whitish-ochreous streak along inner margin from base to apex, occupying nearly half of wing; three indistinct small black discal spots, sometimes obselete, first in middle, second on lower margin of dark fuscous portion very obliquely before first, third in disc beyond middle: cilia pale whitish-ochreous, on costa mixed with dark fuscous. Hindwings with apex tolerably acute, hindmargin gently sinuate; whitish-grey; cilia ochreous-whitish.

Characterised by the straight longitudinal separation of the dark costal and light dorsal halves of the forewings, and the colour of thorax.

Bealey River (2,100 feet), in January; two specimens.

11. *Gel. pharetria*, n. sp.

Male, female.—13–17 mm. Head, palpi, thorax, abdomen, and legs, whitish-ochreous; anterior legs infuscated. Antennæ fuscous. Forewings elongate, narrow, acutely pointed; whitish-ochreous, obscurely irrorated with brownish-ochreous, tending to form streaks on veins, sometimes a more distinct apical streak; sometimes a few scattered black scales, also tending to accumulate on veins; three small black discal spots, sometimes almost obselete, first before middle, second on fold obliquely before first, third beyond middle; apical portion of costa and hindmargin obscurely dotted with black: cilia whitish-ochreous, with two obscure interrupted lines of blackish points round apex. Hindwings with apex round-pointed, hindmargin gently sinuate; whitish-grey; cilia ochreous-whitish.

Closely allied to the following, from which it differs by the brownish irroration, obscure lines on veins, and absence of the dark fuscous median streak; the hindwings are also somewhat less pointed.

Castle Hill and Arthur's Pass (2,500–3,000 feet); locally abundant amongst rough flowery herbage in January.

12. *Gel. monophragma*, n. sp.

Male, female.—11–15 mm. Head, palpi, thorax, and abdomen ochreous-whitish; second joint of palpi externally somewhat irrorated with black, apex of terminal joint black. Antennæ fuscous. Legs dark fuscous, posterior tibiæ and apex of joints ochreous-whitish. Forewings elongate, narrow, acutely pointed; ochreous-whitish, somewhat irrorated with ochreous; a narrow blackish central streak from base to apex, sometimes suffused with ochreous beneath, variable in strength, rarely partially obsolete, and tending to form two separate discal spots towards middle: cilia ochreous whitish. Hindwings with apex acute,

hindmargin moderately sinuate; pale whitish-grey; cilia ochreous-whitish.

Distinguished by the pale colour and blackish median streak, which, though sometimes imperfect, is always traceable; it recalls the considerably darker European *G. mulinella.*

Wellington, Hamilton, and Invercargill; common in dry grassy places in December and January.

13. *Gel. lithodes*, n. sp.

Male.—16 mm. Head, palpi, antennæ, thorax, abdomen, and legs grey, finely sprinkled with whitish; antennæ rather densely pubescent. Forewings elongate, narrow, tolerably acutely pointed; grey, finely irrorated with blue-whitish; three discal spots obscurely darker, first before middle, second on fold rather before first, third in disc beyond middle: cilia whitish-grey. Hindwings with apex round-pointed, hindmargin slightly sinuate; whitish-grey; cilia grey-whitish.

The slaty-grey colouring is imitative of the mountain rock, as in *Scoparia cataxesta* and other species; the antennal pubescence is also a common characteristic of alpine forms.

Arthur's Pass (2,500 feet), in January; one specimen resting on shingle.

14. *Gel. achyrota*, n. sp.

Male, female.—17–18 mm. Head, thorax, and abdomen pale greyish-ochreous mixed with whitish. Palpi whitish-ochreous, basal $\frac{2}{3}$ of second joint, and basal and supramedian bands of terminal joint dark fuscous. Antennæ light greyish-ochreous. Legs dark fuscous, posterior tibiæ above and apex of joints ochreous-whitish. Forewings elongate, apex round-pointed, hindmargin very obliquely rounded; light brownish-ochreous, irregularly mixed with whitish and blackish scales; anterior half of costa suffused with whitish, and dotted with blackish; inner margin between $\frac{1}{4}$ and $\frac{2}{3}$ suffused with blackish; a small black spot on base of costa; four small black discal spots, surrounded with whitish rings, first in disc before middle, second on fold rather before first, their rings confluent, third and fourth dot-like, transversely placed and close together in disc at $\frac{3}{5}$; a cloudy whitish fascia from $\frac{4}{5}$ of costa to anal angle, dentate outwards in middle; a cloudy black hindmarginal line: cilia ochreous-whitish with two dark grey lines, first interrupted, second entire. Hindwings with apex rounded, hindmargin hardly sinuate; grey, towards base paler; cilia ochreous-whitish, with two cloudy grey lines.

Remote from the other New Zealand species of the genus, and approaching *Tachyptilia populella* in form and superficial appearance.

Christchurch and Dunedin; rather common amongst bush, in December and January.

6. ANISOPLACA, n.g.

Head smooth; ocelli present; tongue well developed. Antennæ $\frac{3}{4}$, in male filiform, moderately ciliated (**1**), basal joint elongate, without pecten. Labial palpi long, recurved, second joint thickened with dense scales, forming a short dense triangular projecting tuft towards apex beneath, terminal joint longer than second, slightly roughened anteriorly, acute. Maxillary palpi short, appressed to tongue. Posterior tarsi roughly haired above. Forewings with vein 1 furcate, 2 from $\frac{3}{4}$ of cell, 7 and 8 stalked, 7 to costa, 11 from middle of cell. Hindwings broader by $\frac{1}{3}$ than forewings, trapezoidal, apex and hindmargin rounded, cilia $\frac{2}{5}$; veins 3 and 4 short stalked, 5 from rather near 4, cell longest above, 6 and 7 approximated at base.

15. *Anis. ptyoptera*, n. sp.

Male.—27 mm. Head, thorax, and abdomen very pale whitish ochreous, shoulders narrowly dark fuscous. Palpi ochreous-whitish, basal half of second joint and a spot at base of terminal joint fuscous. Antennæ fuscous. Legs pale whitish-ochreous, irrorated with dark fuscous. Forewings elongate, narrow, posteriorly somewhat dilated, apex obtuse, hindmargin hardly rounded, oblique; very pale whitish-ochreous, with a few blackish scales, and irregularly irrorated with grey except towards costa and apex, and on two round patches surrounding discal spots; costa irrorated with grey towards base; a black dot beneath costa at $\frac{1}{4}$; three small black discal dots, first at $\frac{1}{3}$, the other two transversely placed close together beyond middle: cilia ochreous-whitish, with a grey line, basal third suffusedly barred with grey. Hindwings light grey; cilia whitish, with a grey basal line.

Christchurch, in March; one specimen received from Mr. R. W. Fereday.

DEPRESSARIADÆ.

Head smooth. Antennæ in male simple. Labial palpi recurved, pointed. Maxillary palpi very short, not developed. Forewings with vein 1 furcate at base, 2 from or near angle of cell, 7 and 8 stalked (rarely coincident), 7 to costa or apex (rarely to hindmargin). Hindwings not broader than forewings, hindmargin rounded, veins 3 and 4 from a point or stalked, 6 and 7 separate, nearly parallel.

The family, not a very large one, is but scantily represented in New Zealand and Australia; it is closely allied to the *Œcophoridæ,* from which it differs essentially only by the simple antennæ of male.

7. PHÆOSACES, n. g.

Head loosely haired; no ocelli; tongue well developed. Antennæ $\frac{3}{4}$, in male subserrate, simple, basal joint moderately

elongate, without pecten. Labial palpi long, recurved, second joint thickened with appressed scales, terminal joint shorter than second, acute. Maxillary palpi very short, appressed to tongue. Abdomen not flattened. Posterior tibiæ clothed with long hairs above. Forewings with vein 1 furcate, 2 from near angle, 7 and 8 stalked, 7 to apex, 11 from middle of cell. Hindwings as broad as forewings, trapezoidal-ovate, apex and hindmargin rounded, cilia $\frac{2}{5}$; veins 3 and 4 from a point, 6 and 7 tolerably parallel.

Allied to *Depressaria*, but distinguished by the smoothly-scaled second joint of palpi, the abdomen not flattened, and the termination of vein 7 of the forewings in the apex. So far as known the genus is endemic.

16. *Phæo. compsotypa*, n. sp.

Female.—19 mm. Head, palpi, and antennæ grey-whitish, palpi externally suffused with dark fuscous. Thorax grey-whitish; shoulders, and a longitudinal anterior mark on each side of back, dark fuscous. Abdomen whitish-grey. Legs dark fuscous, suffusedly ringed with grey-whitish. Forewings oblong, costa moderately arched, apex rounded, hindmargin rather oblique, slightly rounded; light greyish-fuscous, irregularly mixed with whitish and blackish scales, towards costa anteriorly broadly suffused with whitish; a small black spot on base of costa; a cloudy dark fuscous spot on fold at $\frac{1}{4}$, connected with inner margin by an inwardly oblique line; a blackish dot in disk at $\frac{2}{5}$, connected with costa at $\frac{2}{5}$ by a dark fuscous line strongly dentate outwards in middle, and a second dot on fold directly beneath first, connected with inner margin by a cloudy irregular inwardly oblique dark fuscous line; a thick cloudy dark fuscous outwardly oblique streak from middle of costa, reaching nearly half across wing; a posterior series of short longitudinal blackish streaks between veins; an interrupted blackish hindmarginal line: cilia light greyish-fuscous mixed with whitish, with a cloudy blackish-grey line. Hindwings whitish, with a broad suffused light-grey border along hindmargin; cilia whitish, with a grey line.

Hamilton; one specimen in January.

17. *Phæo. apocrypta*, n. sp.

Male, Female.—20–28 mm. Head, palpi, antennæ, thorax, and abdomen light greyish-fuscous, palpi externally irrorated with dark fuscous. Legs dark fuscous, suffusedly ringed with whitish, hairs of posterior tibiæ ochreous-whitish. Forewings oblong, posteriorly somewhat dilated, costa moderately arched, apex rounded, hindmargin obliquely rounded; fuscous, sometimes ochreous-tinged, sometimes finely irrorated with grey-whitish; a small darker fuscous spot in disc at $\frac{2}{5}$, a second

almost directly beneath it on fold, and a third in disc beyond middle, all sometimes obsolete; a cloudy curved-angulated line from $\frac{2}{3}$ of costa to inner margin before anal angle hardly darker, preceded by a faint paler shade; an interrupted obscure darker hindmarginal line: cilia light ochreous-brownish, with two indistinct darker lines, tips ochreous-whitish. Hindwings rather light grey; cilia ochreous-whitish, with a cloudy grey line.

The form of wings varies, being usually more oblong in the female than in the male.

Christchurch, Dunedin, and Lake Wakatipu; rather common in December and January.

PLUTELLIDÆ.

Head tolerably smooth. Antennæ in male simple or pubescent, sometimes scaled. Labial palpi recurved, pointed. Maxillary palpi short or moderate, porrected. Forewings with vein 1 furcate, 7 and 8 separate (or in exotic genera sometimes stalked), 7 usually to hindmargin, secondary cell and forked parting-vein usually well-defined. Hindwings elongate-ovate or ovate-lanceolate; veins 3 and 4 separate, 5 and 6, or 6 and 7, usually separate, sometimes stalked.

In all the three following genera the antennæ are projected directly in front of the head in repose. *Plutella* is probably a northern genus, but one species at least, *P. cruciferarum*, is now by the agency of man disseminated through the world; the other two New Zealand species, both new, occur also in Australia, and will probably be found to be not indigenous in either region, but introduced with the weeds of cultivation. The other two genera are endemic, so far as known. *Protosynæma* is especially interesting, indicating in my opinion with certainty the origin of *Glyphipteryx* and its allies, whilst in structure clearly referable here. The free-feeding larvæ, tapering towards both ends, and usually spindle-shaped cocoons of this family, are in general easily recognisable by those familiar with them. I found larvæ of one species of the family feeding on a species of *Carex* in the mountains, but failed to rear them, as they were infested with parasites.

1a. Second joint of palpi tufted .. .. .. 10. *Plutella.*
1b. " " " not tufted.
  2a. Antennæ partially clothed with scales .. 8. *Protosynæma.*
  2b. " not thickened with scales .. 0. *Orthenches.*

8. PROTOSYNÆMA, n. g.

Head smooth; ocelli present; tongue well-developed. Antennæ $\frac{3}{4}$, lower portion thickened with dense clothing of scales, remainder in male with angularly projecting joints, pubescent-ciliated, basal joint moderately elongate, stout, without pecten. Labial palpi moderately long, recurved, with appressed scales,

somewhat rough beneath, terminal joint longer than second, acute. Maxillary palpi short, filiform, acute, porrected. Posterior tibiæ shortly rough-haired beneath. Forewings with vein 1 furcate, 2 almost from angle of cell, 7 to hindmargin, 11 from beyond middle of cell, all veins separate. Hindwings as broad as forewings, elongate-ovate, cilia, $\frac{2}{3}$–$\frac{3}{4}$; veins 3 and 4 remote, 6 and 7 tolerably parallel.

The two species differ much in the extent of the antennal scaling in the male, but comparatively little in the female.

18. *Prot. eratopis*, n. sp.

Male, female.—11$\frac{1}{2}$–12$\frac{1}{2}$ mm. Head yellow-ochreous, face and palpi paler, mixed with white. Antennæ clothed with dense scales in male to $\frac{1}{3}$ above only, in female to $\frac{1}{2}$ all over, brownish-ochreous, apex of scaled portion dark fuscous, naked portion grey. Thorax bronzy-ochreous, with a yellowish-white stripe on each side of back. Abdomen grey. Legs dark grey, posterior tibiæ and apex of joints grey-whitish. Forewings elongate, moderate, apex rounded, hindmargin sinuate, oblique; yellow-ochreous, with somewhat coppery reflections; markings margined with fuscous; a straight white streak from middle of base to near inner margin before middle; a straight narrow silvery-metallic fascia from costa near base to middle of inner margin, sometimes not reaching it; a rather broader oblique white fascia from costa at $\frac{1}{3}$, reaching to fold, attenuated to extremity; a narrow straight silvery-metallic fascia from middle of costa to $\frac{2}{3}$ of inner margin, becoming white towards costa; a narrow straight white fascia from $\frac{2}{3}$ of costa to $\frac{4}{5}$ of inner margin, interrupted by a small round silvery-metallic spot above middle; between this fascia and hindmargin is a large round white spot, crossed by six fine black lines on veins, connected with costa at $\frac{5}{6}$ by a short white bar, beneath margined by a round coppery or violet-metallic black-margined spot at its lower anterior angle, and a black streak along lower half of hindmargin containing three similar coppery or violet-metallic spots; a silvery-metallic streak from costa before apex to hindmargin above middle, becoming white towards costa: cilia ochreous, tips paler, with white spots at extremities of subapical streak. Hindwings and cilia grey.

The superficial resemblance to a typical *Glyphipteryx* is very extraordinary.

Otira Gorge, about 2,800 feet; taken commonly, flying about a flowery bank in January.

19. *Prot. steropucha*, n. sp.

Male, female.—13–14 m.m. Head and thorax dark purplish-fuscous, palpi dark fuscous, second joint yellow-whitish beneath towards base. Antennæ clothed with very dense scales in male to $\frac{3}{4}$, in female to $\frac{2}{3}$, dark purplish-fuscous, naked apical portion

yellow-whitish. Abdomen dark grey. Legs dark purplish-fuscous. Forewings elongate, narrow, apex round-pointed, hindmargin sinuate, oblique; deep ferruginous-bronze, with purplish reflections, finely irregularly irrorated with dark grey and whitish; markings coppery-metallic; a very oblique streak from costa near base to fold; an irregular transverse mark parallel to hindmargin in middle of disc, in female reaching costa in middle, and then appearing as a curved fascia not reaching inner margin; a transverse angulated fascia from beneath costa at $\frac{3}{4}$ to above anal angle, not reaching margins; a hindmarginal fascia, containing two small round deep black spots above anal angle: cilia deep ferruginous-bronze, mixed with dark grey. Hindwings dark fuscous-grey, lighter towards base, sometimes coppery-tinged; cilia grey.

Hamilton and Christchurch, in January, March and June; four specimens.

9. ORTHENCHES, n. g.

Head smooth; ocelli present; tongue well-developed. Antennæ $\frac{4}{5}$, in male filiform, simple or pubescent, somewhat thickened at base, joints angularly projecting, basal joint moderately elongate, with strong pecten. Labial palpi moderate or long, recurved, with appressed scales, somewhat rough beneath throughout except at apex, terminal joint from as long to twice as long as second, acute. Maxillary palpi tolerably filiform, curved, ascending. Posterior tibiæ rough-haired beneath. Forewings with vein 1 furcate, 2 almost from angle of cell, 7 to apex, 11 from $\frac{1}{3}$ of cell, all veins separate, secondary cell strongly defined. Hindwings as broad as forewings, elongate-ovate or ovate-lanceolate, hindmargin sometimes rather sinuate, cilia $\frac{3}{4}$–1; all veins remote, tolerably parallel; beneath sometimes with a neural ridge or pecten in male.

Larva feeding openly or amongst loosely spun leaves.

1a. Apex of forewings acute .. .. 22. *porphyritis.*
1b. " " rounded.
  2a. Head whitish-yellowish .. .. .. 20. *chlorocoma.*
  2b. " grey-whitish .. .. 21. *prasinodes.*

20. *Orth. chlorocoma*, n. sp.

Male.—15 mm. Head and antennæ pale whitish-yellowish. Palpi moderate, yellow whitish, second joint with a dark grey subapical band, terminal joint as long as second. Thorax pale whitish-yellowish, sides brownish. Abdomen ochreous-whitish. Legs fuscous, beneath whitish, anterior pair blackish. Forewings elongate, narrow, costa slightly sinuate, apex and hindmargin rounded; fuscous-whitish, towards costa and base slightly yellowish-tinged, with thin irregular blackish irroration throughout, tending to accumulate in small spots, especially on margins; a small round black spot in disc at $\frac{5}{8}$: cilia pale whitish-yellowish, suffusedly barred with blackish-grey. Hindwings elongate-ovate,

with a scaled membranous ridge along lower median vein beneath; grey-whitish; cilia grey-whitish, at apex pale whitish-yellowish, with a blackish-grey spot.

Larva 16-legged, slender, attenuated towards both extremities, especially posteriorly; whitish-brown or whitish-green; a straight slender dorsal line and two rather irregular ill-defined lines on each side of it ochreous-brown or green, according to ground colour; beneath these a rather broad yellowish-white spiracular line; space beneath this dull brown; spots minute, black; head grey-whitish or greenish-whitish, irregularly striped longitudinally with dark fuscous. Feeds openly on *Carmichælia australis* (*Leguminosæ*), gnawing the twigs (the plant being leafless). Pupa in a rather thin firm spindle-shaped cocoon.

Christchurch; three larvæ found in March, from which I bred one specimen in April.

21. *Orth. prasinodes*, n. sp.

Male.—14 mm. Head and antennæ grey-whitish. Palpi moderately long, grey-whitish, second joint, except apex, and base of terminal joint dark fuscous, terminal joint somewhat longer than second. Thorax light greenish-grey, suffusedly mixed with dark grey. Abdomen grey-whitish. Legs dark fuscous, apex of joints and posterior tibiæ grey-whitish. Forewings elongate, costa sinuate, apex and hindmargin rounded; light dull greenish, disc, inner and hind margins much suffused with dark grey, rest of wing indistinctly dotted with black, costa more distinctly; a small pale spot in dark suffusion below middle of fold; a small black spot in disc at $\frac{2}{3}$, preceded by a pale longitudinal streak in disc: cilia grey, mixed with grey-whitish. Hindwings elongate-ovate, beneath with a long thin pecten of hairs from vein 1c directed towards disc; pale whitish-grey; cilia grey-whitish, with a dark grey spot at apex.

Christchurch; one specimen in March, amongst bush.

22. *Orth. porphyritis*, n. sp.

Male, female.—11–14 mm. Head light ochreous. Palpi long, light ochreous or whitish, externally suffused with dark fuscous, terminal joint twice as long as second. Antennæ whitish, annulated with dark fuscous. Thorax ochreous, mixed and suffused with purplish and dark fuscous. Abdomen grey. Legs dark fuscous, apex of joints and posterior tibiæ whitish. Forewings elongate, narrow, costa arched, apex acute, hindmargin very obliquely sinuate; brownish-ochreous, with purple or coppery reflections, sometimes mixed with grey-whitish; an irregular irroration of small dark fuscous spots; markings suffused, deep bronzy or violet-fuscous, very variable; normally a fascia-like rather oblique streak from costa at $\frac{1}{4}$, usually abbreviated, but sometimes reaching inner margin, an irregular

median fascia parallel to this, connected by a bar with costa at $\frac{3}{4}$, and a narrow fascia from costa before apex to anal angle, but these are sometimes incomplete or partially suffused; in one specimen, traces of a longitudinal white median streak: cilia brownish-ochreous, with a dark fuscous spot at apex. Hindwing ovate-lanceolate, apex acute, hindmargin sinuate; grey, towards apex darker; cilia grey.

Larva 16-legged, moderate, cylindrical, rather tapering at both ends; dull light greenish-ochreous; dorsal narrow, ochreous-whitish, bordered on each side by a slender dull reddish-fuscous streak, coalescing towards extremities; head brownish-ochreous. Feeds amongst loosely spun-together leaves of *Podocarpus totara* (*Coniferæ*). Pupa in a thin cocoon.

Otira River, Dunedin, and Invercargill, in September, December, and January; five specimens; larvæ found in December produced an imago in January.

10. PLUTELLA, Schrk.

Head with loosely appressed hairs; ocelli present; tongue well developed. Antennæ $\frac{3}{4}$, towards base somewhat thickened, serrate, in male simple, basal joint moderate, with a dense anterior flap of scales. Labial palpi moderately long, recurved, second joint beneath with long dense projecting tuft of scales towards apex, terminal joint as long as second, slender or somewhat rough anteriorly, acute. Maxillary palpi very short, filiform. Posterior tibiæ shortly haired beneath. Forewings with vein 1 furcate, 2 from rather near angle, 7 to hindmargin, 11 from or before middle of cell, secondary cell more or less well-defined, all veins separate. Hindwings as broad as forewings or somewhat broader, elongate-ovate or ovate-lanceolate, cilia $\frac{2}{3}$–$1\frac{1}{4}$; veins 3 and 4 more or less remote, 5 and 6 stalked or separate, 7 remote.

The known larvæ are 16-legged, somewhat tapering to both ends, and all feed on *Cruciferæ*. Probably none of the three following species is indigenous:—

1a. Apex of hindwings acute	.. 23. *cruciferarum.*
1b. ,, ,, ,, rounded.	
2a. Hindmargin of forewings concave ..	.. 25. *psammochroa.*
2b. ,, ,, ,, not concave	.. 24. *sera.*

SECT. A.—Veins 5 and 6 of hindwings stalked.

23. *Plut. cruciferarum*, Z.

Male, female.—13–14 mm. Head and thorax in male ochreous-white, sides of thorax fuscous, in female wholly grey-whitish, mixed with grey. Palpi dark fuscous, base and terminal joint whitish. Antennæ whitish, annulated with fuscous, and with generally five dark fuscous bands. Forewings elongate, narrow, tolerably pointed, in male with a pencil of hairs beneath from base of costa; light fuscous, sometimes partially

ochreous-tinged, somewhat mixed with whitish, with a scanty irroration of small blackish spots, larger and more numerous in female; costal edge white in male, especially towards $\frac{2}{3}$; in male a longitudinal white line about fold from base, above margined with dark fuscous or blackish, beneath shading into a pale ochreous dorsal space, twice slightly sinuate upwards, towards anal angle bent upwards and becoming obsolete; in female this line is indistinct, the dorsal space hardly paler than ground-colour, but upper black margin tolerably distinct, the sinuations angulated and much more prominent than in male: cilia grey-whitish, somewhat irrorated with grey, with four dark fuscous lines. Hindwings ovate-lanceolate, grey; cilia whitish grey, towards tips more whitish.

A variable species.

Larva green, feeding on cabbages and other *Cruciferæ*, to which it is sometimes exceedingly destructive, eating the leaves into holes. Pupa in an open network cocoon.

Cambridge, Wellington, Taranaki, Christchurch, Bealey River, Lake Wakatipu, and probably universally; abundant in the neighbourhood of gardens from August to March. Introduced from Europe, and now occurring probably throughout the world; in Australia often very numerous.

Sect. B.—Veins 5 and 6 of hindwings separate.

24. *Plut. sera*, n. sp.

Male, female.—11–13 mm. Head whitish-ochreous. Palpi whitish-ochreous, more or less mixed with dark fuscous. Antennæ ochreous-white, with median and posterior bands and two subapical rings dark fuscous. Thorax light brownish-ochreous, anterior margin mixed with dark fuscous. Abdomen whitish-grey. Legs dark fuscous, apex of joints and posterior tibiæ whitish-ochreous. Forewings elongate, rather narrow, costa arched, apex round-pointed, hindmargin hardly rounded, very oblique; light brownish-ochreous mixed with grey, and with a scanty irroration of small black spots; a crescentic black mark on fold before middle, extremities directed upwards, posterior tending sometimes to be produced as a cloudy streak to costa beyond middle; a fuscous streak from inner margin at $\frac{3}{4}$ towards costa near apex, but becoming obsolete before reaching it, margined with black towards lower extremity, sometimes little darker than ground colour; a blackish line along upper part of hindmargin: cilia whitish-ochreous with a black line, a blackish spot at apex and a larger one below middle of hindmargin. Hindwings elongate-ovate, light grey; cilia grey-whitish.

Most allied to the European *P. annulatella*.

Taranaki, Makatoku, and Palmerston, in March; also common in Eastern Australia, where the imago is on the wing most of the year, frequenting the neighbourhood of cultivation.

25. *Plut. psammochroa*, n. sp.

Male, female.—16–20 mm. Head, palpi, antennæ, thorax, abdomen, and legs whitish-ochreous; head and thorax sometimes with two obscure darker longitudinal stripes; second joint of palpi sometimes with dark fuscous subapical band; anterior legs suffused with dark fuscous. Forewings elongate, rather narrow, costa arched, apex acute, hindmargin concave, oblique; whitish-ochreous; all veins distinctly lined with ochreous-fuscous; a few irregularly scattered black dots: cilia whitish-ochreous. Hindwings somewhat broader than forewings, elongate-ovate; pale whitish-grey; cilia grey-whitish.

Differs from all by the concave hindmargin of forewings.

Otira River, in January; also from Eastern Australia; three specimens.

MICROPTERYGIDÆ.

Head rough or loosely haired. Antennæ in male filiform, simple or pubescent. Labial palpi moderate or short, straight, porrected or drooping. Maxillary palpi moderate or long, porrected or folded. Forewings with venation normal or complex, often with additional veins and subdivisions of cell. Hindwings ovate-lanceolate or lanceolate, neuration nearly as in forewings, with not less than 9 veins rising out of cell.

This is the ancestral family of the *Tineina*, and may be always known by the more complex neuration of the hindwings, which is not essentially differentiated from that of the forewings. In the older genera of the family the neuration cannot be strictly referred to the Lepidopterous type at all, but is really Neuropterous in character, and undoubtedly indicates the origin of the *Lepidoptera* from that group. In these genera there are several additional veins, and usually several separate cells, the whole presenting a structure which could not possibly be evolved from the normal Lepidopterous type, since such a process would require the creation of the new veins, whilst the Lepidopterous type can readily be deduced from it by the disappearance or modification of existing veins. In the case of these genera the description of the neuration should require, in consequence, an entirely new terminology; but, although the course is not strictly logical, I have thought it more intelligible to maintain for the forewings the assumption of the normal Lepidopterous type in these genera, keeping for equivalent veins their usual designation, and treating those which are without analogue in the normal type as superadded.

Besides the following, only a few European species are authentically known; I have not succeeded in finding any representative of the family in Australia. The two genera occurring here are both endemic; *Palæomicra* is probably the oldest known genus of the order; *Mnesarchæa* is very interesting

as exhibiting a step in transition to the *Erechthiadæ* and *Plutellidæ*. The species described here are all very difficult to see when on the wing, and therefore likely to be passed over. The known exotic larvæ are apodal and miners.

Under the head of *Palæomicra* I give a comparison of the neuration of that genus with those *Neuroptera* (*Trichoptera*) which approach it most nearly.

1a. Forewings with additional costal veins; labial palpi very short .. .. 12. *Palæomicra.*
1b. Forewings without additional veins; labial palpi rather long, brushlike .. .. .. 11. *Mnesarchæa.*

11. Mnesarchæa, n. g.

Head loosely haired, somewhat rough; ocelli present; tongue obsolete. Antennæ $\frac{3}{4}$, stout, filiform, in male simple, basal joint moderate, without pecten. Labial palpi moderately long, straight, porrected, clothed with long loose scales forming a dilated terminal brush. Maxillary palpi moderate, porrected, terminating in a loose dilated brush. Abdomen in male with uncus and valves well developed, and two long linear internal processes. Posterior tibiæ thinly clothed with long bristles, middle and posterior tarsi with whorls of projecting bristles at apex of four basal joints. Forewings with vein 1 simple, 2 almost from angle of cell, 6 out of stalk of 7 and 8 near base, 7 and 8 stalked, 7 to hindmargin, 11 absent. Hindwings $\frac{4}{5}$ of forewings, lanceolate, cilia rather over 1; neuration exactly as in forewings, except that vein 6 is separate from 7.

26. *Mnes. paracosma*, n. sp.

Male, 9–10 mm. Head, palpi, and antennæ whitish-ochreous. Thorax light brownish-ochreous. Abdomen grey. Legs dark grey, bristles whitish-ochreous. Forewings lanceolate; yellowish-ochreous, suffusedly mixed with dark fuscous and a few grey-whitish scales, except towards costa anteriorly; a grey-whitish oblique wedge-shaped streak from middle of costa, reaching almost to anal angle; the dark fuscous scales tend to form a spot in disc before this; a deeper suffusion beyond it, especially towards costa, and a spot towards inner margin before middle: cilia light brownish-ochreous, somewhat mixed with dark fuscous and whitish. Hindwings fuscous-grey, somewhat purple-shining; cilia grey.

Lake Wakatipu (1,100 feet), and Invercargill; nine specimens, flying amongst rough herbage in December.

12. Palæomicra, n. g.

Head with long rough hairs; ocelli present; tongue obsolete. Antennæ $\frac{1}{2}$–$\frac{2}{3}$, in male filiform, pubescent, basal joint small, concealed. Labial palpi extremely short, rudimentary. Maxillary palpi long, folded, loosely scaled. Abdomen in male

with rounded terminal plate above, valves large. Middle tibiæ without spurs; posterior tibiæ somewhat rough beneath. Forewings with vein 1*a* with long basal furcation, lower fork sometimes (*chalcophanes*) again basally furcate, 1*b* well-defined, connected with lower margin of cell by a bar near base, 2 and 3 from point of angle, transverse vein sometimes (*chalcophanes*) obsolete between 3 and 4, forked parting-vein well-defined, rising out of lower margin of cell near base, sometimes (*chalcophanes*) connected with upper margin by a bar near base, terminating in 4 and 5, between which transverse vein is absent, 7 and 8 stalked, 7 to hindmargin, secondary cell well-defined, 9 and 10 out of its upper margin, 11 from $\frac{1}{3}$ of cell, giving rise to an additional vein, and connected with 12 by a bar above (*chrysargyra*) or below (*chalcophanes*) the additional vein, 12 sometimes (*chalcophanes*) connected with upper margin of cell at base, giving rise to an additional vein above in middle, and sometimes (*chalcophanes*) a second near base. Hindwings rather narrower than forewings, ovate-lanceolate, cilia $\frac{3}{4}$; neuration identical with that of forewings, except as follows: 1*b* rising out of upper fork of 1*a*, not connected with cell, 2 and 3 remote, transverse vein between 3 and 4 well-defined, the four main veins not connected at base of wing, 11 from middle of cell, 11 and 12 without additional branches.

Differs from the typical genus *Micropteryx* (which requires subdivision on the basis of neuration) by the stalking of veins 7 and 8 in both wings, and the additional branch of 11 in forewings.

I sent drawings of the neuration of this genus to Mr. R. McLachlan, the well-known neuropterist (whom I am glad to be able to quote as agreeing with me that there is a real and close developmental connection between this genus and the *Trichoptera*), with the request that he would express an opinion as to which genera of *Trichoptera* it approached most nearly. In reply he kindly furnished me with figures of several, with which it is practically almost identical. The nearest of these is *Rhyacophila* (*Rhyacophilidæ*); *Cyrnus* and *Holocentropus* (*Hydropsychidæ*) also approximate closely, and *Diplectrona* and *Hydropsyche*, in the same family, less nearly; *Calamoceras* (*Leptoceridæ*) is rather more remote. In the forewings of *Rhyacophila* the only important difference is the existence of an additional vein rising out of 4; but in the hindwings one observes with interest that this very difference has disappeared, this additional vein being absent; throughout these genera it seems that, in the tendency to a progressive simplification of structure, the hindwings took the lead, with the result that in the final established Lepidopterous type the hindwings have permanently four veins less than the forewings. *Rhyacophila* shows no other essential distinction from *Palæomicra*; the other

points of difference consist in the position (whether above or below the furcations) of the transverse bars, or their partial obsolescence. *Pal. chalcophanes* is especially interesting, as being at present the only Lepidopteron known which shows the basal trifurcation of vein 1*a* of the forewings, common to all the above-mentioned genera of *Trichoptera*; and the same species possesses the second (basal) branch of vein 12 of the forewings, which is shown in *Rhyacophila*, but not in any of the others mentioned, except *Hydropsyche*, which does not, however, show the other or median branch. I may add that this basal branch is perhaps rather to be regarded as a transverse bar connecting vein 12 with the costa, than as a true branch. It appears to me that the type of neuration of the *Trichoptera* consists of five simple veins, variously fused, towards the inner margin; and seven apically furcate veins, variously fused towards the base, and connected by a series of transverse bars.

27. *Pal. chalcophanes*, n. sp.

Male, female.—10½–11 mm. Head, palpi, and thorax ochreous. Antennæ pale ochreous, with about six very variable blackish bands. Abdomen grey. Legs pale ochreous, sharply banded with dark grey. Forewings oblong, costa abruptly bent near base, thence gently arched, apex acute, hindmargin straight, very oblique; light shining yellowish-ochreous, with hardly traceable somewhat darker coppery-shining oblique reticulating fasciæ, terminating in small dark purple-fuscous spots on margins; these spots are on costa near base, at ⅓, ⅔, ⅚, and apex, on inner margin near base, at ⅓, ⅔, and anal angle, and on middle of hindmargin; third costal spot often double; cilia shining whitish-ochreous, on costal spots dark fuscous. Hindwings rather dark purple-grey; cilia grey.

Makatoku (Hawke's Bay), in March; nine specimens amongst deep forest.

28. *Pal. chrysargyra*, n. sp.

Male, female.—9–10½ mm. Head and thorax reddish-ochreous. Palpi light ochreous. Antennæ dark grey. Abdomen grey. Legs light ochreous. Forewings ovate-lanceolate, costa abruptly bent near base, thence moderately arched, apex acute, hindmargin very oblique, slightly sinuate; shining golden-ochreous; markings very indistinct, shining ochreous-whitish; a very irregular fascia before middle, a second at ⅔, both often interrupted, and a series of several small spots along hindmargin and apical portion of costa; a dark fuscous dot in disc before middle, sometimes obsolete: cilia pale shining golden-ochreous. Hindwings purplish-grey; cilia whitish-grey.

Lake Wakatipu (1,100 feet), in December; taken commonly flying over flowery herbage by the side of a small rivulet.

GRACILARIADÆ.

I add a new genus and species to those already described.

13. CONOPOMORPHA, n. g.

Head smooth; no ocelli; tongue moderate. Antennæ $1\frac{1}{2}$, in male filiform, simple, basal joint moderate, rather flattened. Labial palpi moderately long, curved, rough-scaled beneath throughout, second joint not reaching base of antennæ, terminal joint acute. Maxillary palpi rather long, slender, porrected. Posterior tibiæ thinly clothed with rough hairs above, tarsi twice tibiæ. Forewings very narrow, parallel-sided, round-pointed; 1 simple, 2 from near angle, 3 and 4 short-stalked from angle, 7 to costa, 9 and 10 from close together, 11 absent, upper margin of cell obsolete towards base. Hindwings half as broad as forewings, almost linear, cilia 5; transverse vein absent between 3 and 5, 4 absent, 5 and 6 as though from a point, 7 free.

29. *Con. cyanospila*, n. sp.

Male, female.—12–14 mm. Head ochreous-whitish, sometimes suffused with fuscous. Palpi whitish, second joint dark fuscous except apex, terminal joint with dark fuscous band and subapical ring. Antennæ grey. Thorax ochreous-whitish, mixed with dark fuscous. Abdomen grey. Legs dark fuscous, apex of joints and oblique bands of tibiæ whitish. Forewings dark fuscous, irregularly mixed with whitish-ochreous, tending to form small scattered cloudy spots or strigulæ; costa dotted with whitish, with three white strigulæ towards base, first two rather inwardly, third outwardly oblique, a suffused pair beyond middle, and three oblique pairs towards apex, first of these meeting a similar pair from inner margin, preceded in disc by a small white spot, and followed by a metallic-blue spot; two oblique whitish strigulæ from inner margin beyond middle, and sometimes one or two others beneath fold; a transverse metallic-blue ante-apical line; a small metallic-blue apical spot: cilia grey, round apex whitish, with dark fuscous lines. Hindwings dark fuscous; cilia grey.

Taranaki, Palmerston, Makatoku, and Masterton; common in February and March amongst dense forest. In repose the imago sits either with the fore-part raised as in *Gracilaria*, or closely appressed to surface, but with the four anterior legs laterally extended; the latter position is apparently most habitual, serving to conceal it on the tree-trunks on which it usually sits.

ART. XXXVI.—*Notes on Nomenclature of New Zealand* Geometrina.

By E. MEYRICK, B.A.

[*Read before the Philosophical Institute of Canterbury, 1st October*, 1885.]

THE publication of Scudder's "Nomenclator Zoologicus" has enabled me to ascertain that in adopting a certain class of generic names in the *Geometrina* I committed a great indiscretion, since these names appear to have been mostly already employed generically. I have, therefore, re-named those genera which had titles pre-occupied by others, reverting to my usual system. The following changes are made:—

Parysatis, Meyr., to be *Paradetis*, Meyr.
Panopæa, Meyr., to be *Pancyma*. Meyr.
Eurydice, Meyr., to be *Homodotis*, Meyr.
Harpalyce, Meyr., to be *Probolæa*, Meyr.
Stratonice, Meyr., to be *Arctesthes*, Meyr.
Thyone, Meyr., to be *Asaphodes*, Meyr.
Hermione, Meyr., to be *Aulopola*, Meyr.
Hippolyte, Meyr., to be *Epicyme*, Meyr.
Arsinoe, Meyr., to be *Anachloris*, Meyr.
Pasithea, Meyr., to be *Notoreas*, Meyr.
Statira, Meyr., to be *Stathmonyma*, Meyr.
Atossa, Meyr., to be *Epicasis*, Meyr.
Phyllodoce, Meyr., to be *Gonophylla*, Meyr.

For *Amastris*, Meyr., the name of *Sestra*, Walk., may be adopted.

The genus described as *Scotosia*, Stph., is (as I have pointed out elsewhere) not the true *Scotosia*, but is identical with *Cephalissa*, Meyr., with which it may be included, the points of distinction relied on being found insufficient.

Cacopsodos, Butl., is identical with *Dichromodes*, Gn., which latter name must be retained; the species will therefore be *Dichromodes nigra*.

ART. XXXVII.—*On the Spiders of New Zealand.*

By A. T. URQUHART.

[*Read before the Auckland Institute, 19th October*, 1885.]

Plates VI.–VIII.

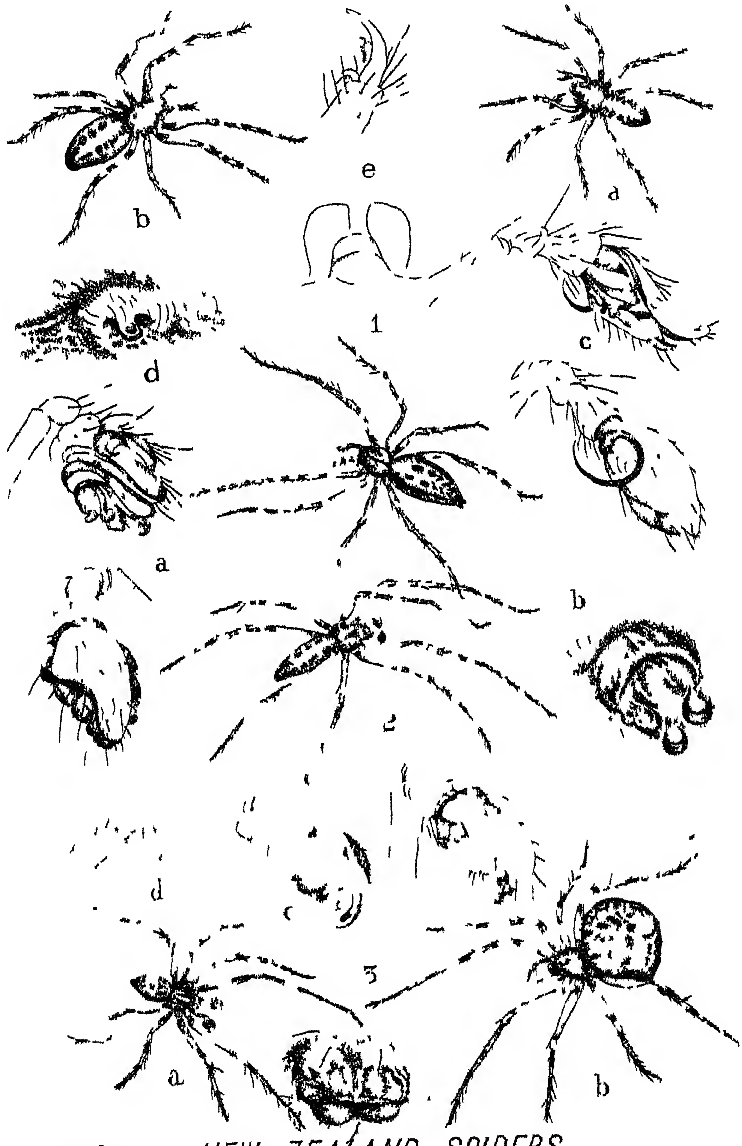
Fam. THERIDIIDÆ.

Genus **Linyphia**, Latr.

Linyphia diloris, sp. n. Pl. VI., fig. 1.

Length of an adult female 5 mm., and of an adult male 4 mm.

Cephalothorax oval; mahogany-brown, rugulose; lateral marginal constrictions at caput moderate; median indentation



ATU del NEW ZEALAND SPIDERS.

longitudinal; normal grooves moderate; profile line level, slightly curved at either end; *clypeus* vertical, in height rather more than half facial space.

Eyes on dark spots; four intermediate form a trapezoid longer than broad; anterior-centrals dark, close, much the smallest of eight; posterior pair rather less than their diameter apart, and more than twice that distance from posterior laterals next to them; hind-centrals and laterals, which are largest of the eight, and placed contiguously to each other on moderate tubercles, have a pearl-grey lustre; anterior row of eyes straight, posterior row slightly curved, convexity of curve directed backwards.

Legs moderately long, relative length 1, 4, 2, 3; i.–iv. nearly equal; yellowish-brown colour, faint olivaceous annulations; armature erect hairs, spine on tarsi of first pair, and spines on tarsi and metatarsi of hind pairs; superior tarsal claws, 1st pair, moderately strong, curving at free end; 13 close, short teeth, increasing in length, pointing backwards; inferior claw smaller than superior, bent, point directed forwards, two short close teeth pointing forwards, basal tooth shortest.

Palpi resemble legs in colour; palpal claw fine, straight, two short teeth near base, pointing forwards.

Falces vertical, prominent at base, divergent, mahogany-brown; four sharp teeth outer row, two central long.

Maxillæ somewhat roundly truncated on outer side, tapering at extremity, inclined towards *lip*, which is about as broad as long, prominently recurved.

Sternum cordate, pitted. These parts have a dark mahogany hue.

Abdomen oval, projects over base of cephalothorax; light-brown, small creamy spots; two blackish undulating bands extend along the dorsal surface, converging towards each other at anterior and posterior ends; sides and ventral surfaces light brown, fine hairs. *Vulva* yellowish-brown, semicircular, transversely wrinkled eminence, concave within; talica on posterior side looped up; projecting from above is a ladle-like apophysis; translucent yellow, reddish extremity.

The *male* resembles the female in form, colour, and markings, but is rather slimmer and shorter. *Palpi* have tints of legs; humeral joint long; cubital short; radial cup-shaped; digital oviform, tapering at extremity; convex and hairy externally; concave within, comprising palpal organs, which are complex, most noticeable on outer side, two short apophyses directed downwards; projecting at apex is a semi-transparent, concave, pointed, greenish membrane; springing from the inner side, near the articulation at the two joints, is a remarkably long, slender, curved dark process.

This species is common in damp spots beneath open manuka, under long grass, etc; spins a fine horizontal web across hollows. Pairs in October–November.

Te Karaka, Auckland, *A.T.U.*

Linyphia trisphathulata, sp. n. Pl. VI., fig. 2.

Length of an adult female 3 mm., and of an adult male 3 mm.

Cephalothorax oval, moderately constricted at caput; rugulose, glossy, yellowish, or light greenish-brown; lateral margins and wide median band dark olive-green; median indentation somewhat lozenge-shaped, apex directed posteriorly; normal grooves rather faint; *clypeus* slightly concave, projects forwards; equals half depth of facial space.

Eyes disposed in two slightly arched transverse rows, forming a narrow oval space; four centrals form a trapezoid, longer than broad; anterior pair close, darkest and much the smallest of eight; hind-centrals largest of eight, placed on black oval tubercular eminences, rather more than their diameter from each other, and the hind-laterals next to them; lateral eyes seated obliquely on rather strong black tubercles, more than their diameter apart, and less than that space from the fore-centrals.

Legs slender, long; relative length 1, 4, 2, 3; i., ii., iv. nearly equal; colour of cephalothorax; tibiæ and metatarsi have olivaceous annulations; armature few dark hairs and slender spines; superior tarsal claws, 1st pair, rather weak, slightly curved, about 10 short, close teeth, increasing in length; inferior claw smaller than superior, bent, one tooth, point behind.

Palpi have tints and armature of legs; palpal claw weak, straight, apparently no teeth.

Falces vertical, slightly divergent; pale-amber; three teeth outer row, inner small points.

Maxillæ nearly twice as long as broad, obliquely truncated on outer side, inclined towards *lip*, which is about as broad as long, everted, dark hue.

Sternum broad cordate, blackish-brown, pitted.

Abdomen ovoid, pointed posteriorly, projects forwards; petiolum rather long; yellowish or brownish mottled with a lighter tint; two irregular (in some examples partially composed of spots) dark-chocolate bands converge from base towards spinners; at posterior end are a series of dark angular lines whose vertices are directed forwards. *Vulva* somewhat circular, prominent, membranous, rugose, brownish eminence, concave within; tibia on posterior side produced into clear pale-amber coloured ladle-shaped apophyses with reddish margins, projecting from between the latter is a similar but longer apophysis.

Male does not differ essentially from female, legs rather longer, and abdomen slimmer; specific pattern in some examples

consists of a double row of spots. *Palpi* pale yellow; humeral joint long, cubital and radial short, latter cup-shaped, few dark strong hairs; digital joint large, ovoid, convex, and moderately hairy externally; palpal organs complex, series of flattish lobes projecting forwards; on upper side, close to articulation of digital and radial joints, is a remarkable dark-red crescent-shaped process. Projecting forwards on the lower side is a pale greenish membrane, margins dark, rounded, serrated.

Taken amongst low vegetation; forms a fine open horizontal web across hollows in shady places. Commences pairing about November.

Te Karaka, Auckland, *A.T.U.*

Genus **Theridium**, Walck.

Theridium varium, sp. n. Pl. VI., fig. 3.

Length of an adult female 7 mm., and of an adult male 4½ mm.

Cephalothorax broad oval, moderately constricted in front; yellowish-brown, suffused about margins and furrows with dark brown; median fovea somewhat oval, deep; radial and caput striæ moderate; profile contour low arch; *clypeus* slightly prominent, in height more than half facial space.

Eye disposed in two transverse curved rows, forming a narrow oval space; four centrals form a quadrilateral figure rather longer than broad; hind-centrals rather more than their diameter apart, and a diameter and a half from the hind-laterals; fore-centrals dark, seated on brown tubercular prominences; laterals close, placed obliquely on moderate tubercles; these eyes and hind-centrals have a pearly lustre.

Legs long, moderately slender; 1, 4, 2, 3 = 16, 13, 11, 8 mm.; clear light-brown, annulated; armature strong dark hairs and bristles; superior tarsal claws, 1st pair, moderately strong and curved, free, and more than half claw, tip bent; 6 teeth, 5 basal rather strong comb-teeth, increasing in length; outer strongest and longest, curved backwards; inferior claw smaller than superior, sharply bent, one curved tooth.

Palpi colour and armature of legs; palpal claw short, sharply curved, 7 long open comb-teeth, forming an even line with point of claw.

Falces conical, slender, nearly vertical, yellowish-brown, few sharp teeth.

Maxillæ long, obliquely truncated on outer side, yellowish-brown, inclined towards *lip*, which is twice as broad as long.

Abdomen large, very convex above, projects over base at cephalothorax; pointed at spinners; ground colour light-brown, spotted and blotched with dark greenish-brown, few light streaks; median band irregular, somewhat leaf-like, between it and spinners are a few angular marks, apices directed forwards;

lateral margins dark oblique streaks; branchial opercula orange-red. *Genital* organ large, concave within; anterior membrane or labrum forms a narrow transversely wrinkled hood, centrally produced into a tapering process, directed backwards; labium large, dark, everted.

Male much smaller than female, less distinctly marked, tints darker. Actual and relative length of *legs* differ from females, 1, 2, 4, 3 = 14, 11, 9, 7 mm.

Palpi furnished with black hairs, have the bright-reddish hue of legs, with exception of radial and digital joints, which have a blackish-brown tint; humeral joint long, cubital and radial short, latter cup-shaped; digital joint oval, convex, and hairy externally, convexities directed towards each other; concave within, palpal organs simple lobes, terminating with a broad, concave, curved greenish membranous process, with dark margins.

(*a*) *Cephalothorax* light yellow-brown, faintly suffused with dark tint. *Legs* shade lighter than cephalothorax, annuli moderately marked. *Abdomen* dull, pale yellow-brown, spotted and marked with dark-brown, specific pattern more or less obliterated. *Male* has more or less light tints of female.

(*β*) *Cephalothorax* glossy brown-black. *Legs* clear light-brown, or greenish-brown, annulations dark. Pattern on *abdomen* resembles type form, but darker. Male has the characteristic dark coloration of the variety.

(*γ*) Marks on *abdomen* black, resemble type form, ground colour slaty-grey, mottled with creamy-white.

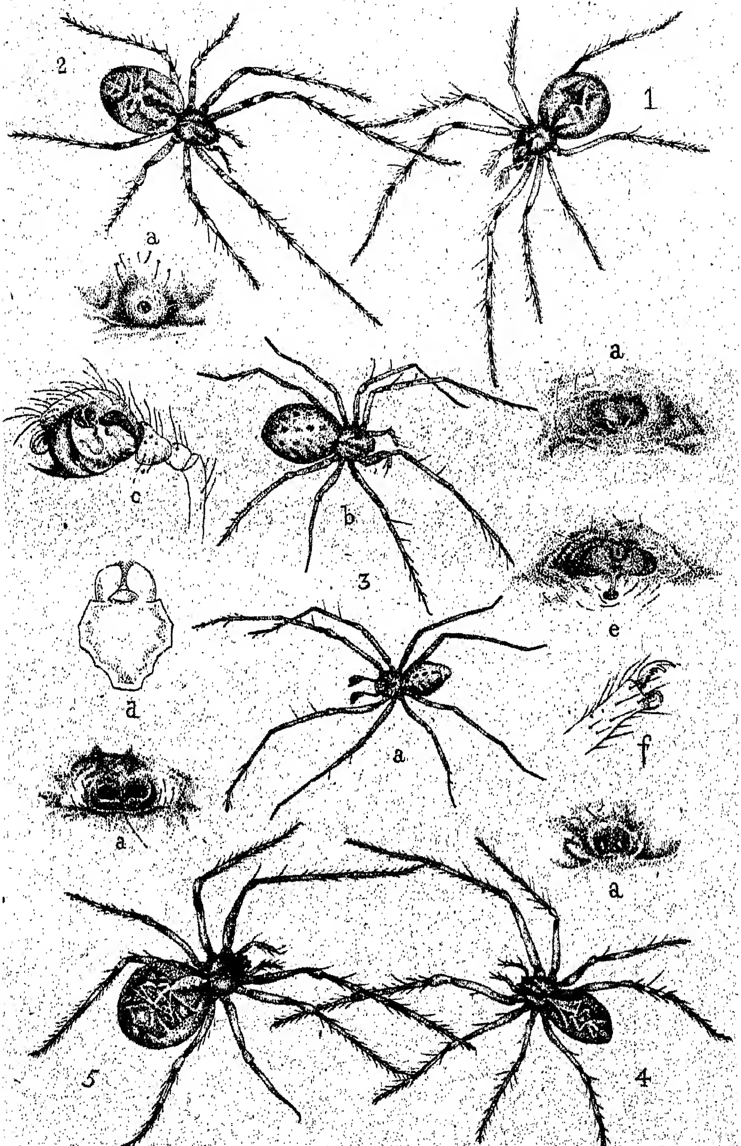
This species is common about buildings, and is to be met with on shrubs. Commences pairing about October; young rarely hatched before November. Cocoons are fabricated throughout the summer until the end of May, when mature examples—as is generally the case with species of this family—become scarce during the winter months. The female usually constructs from 2 to 4 pea-shaped cocoons about 10 mm. in depth, composed of light-brown silk, of a soft felty texture, containing from 60–350 unagglutinated spherical straw-coloured eggs. The web is of normal form—viz., a series of lines intersecting one another in different planes, and at various angles.

Te Karaka, Auckland, *A.T.U.*

Theridium veruculatum, sp. n. Pl. VII., fig 1.

Length of a mature female 4–4½ mm., and of an adult male 3 mm.

Cephalothorax oval, moderately constricted in front; glossy, yellowish-brown colour, suffused with a darker hue; caput convex, well-defined; indentation below eyes; thoracic fovea large, somewhat circular; radial striæ moderate; contour of profile arched; *clypeus* prominent, in height about equal to depth of ocular area.



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Four central *eyes* nearly form a square; fore-pair furthest apart, dark, placed on prominent tubercles, hind-pair less than their diameter apart; laterals contiguous, seated obliquely on moderate tubercles; hind-laterals more than their diameter from posterior median eyes; fore-laterals close to anterior-centrals; side and hind intermediate eyes have a pearl-grey lustre.

Legs slender, relative length 1, 4, 2, 3 = 9, 7, 6, 4½ mm.; clear pale-brown, dark annuli, furnished with black hairs and fine erect bristles; superior tarsal claws, 1st pair, moderately strong and curved, seven comb-teeth pointing forwards, increasing greatly in length and strength, apical teeth have form of free end of claw, and are directed outwards; inferior claw smaller than superior, sharply bent, free and long and fine, one strong tooth, point behind.

Palpi slender, clear pale-brown, terminal joints reddish-brown, digital joint furnished with strong black hairs; palpal claw has seven teeth, increasing in length, directed forwards.

Falces slender, vertical, brownish-amber colour.

Maxillæ long, linear, obliquely truncated on outer side, yellowish, inclined towards *lip*, which is broader than long, obtuse, dark.

Sternum cordate, brownish.

Abdomen broad-oval, slightly cleft at base, very convex above, pointed at spinners; clothed with nearly erect light hairs, ground colour brownish, mottled and marked with various tints of brown, buff, and purple; a purple and brown lance-like mark with buff margins extends more than half across median line, on lateral margins are a series of oblique marks; ventral surface brownish-yellow, fine hairs. Between branchial opercula extends a transverse greenish-brown eminence, semicircular on anterior side, in centre of eminence is a somewhat circular depression—the genital organ; labia on posterior side terminate in two dark, conical processes directed outwards.

The *male* is only 3 mm. in length, does not differ essentially in colouration or markings from female; *cephalothorax* more elongated; *abdomen* slimmer, petiolum exposed. Only marked difference in *legs*, little shorter. *Palpi* moderately long and slender, straw-coloured, except two apical joints which have an amber hue. Humeral joint long; cubital and radial short, about equal in length, furnished with bristles, latter joint cup-shaped; digital joint oviform, convex, and sparsely haired externally, convexities directed towards each other; palpal organs simple, form a glossy, rugose lobe, partially truncated, with slight dark indentation at about two-thirds of its length, tapering and roundly pointed at apex; connected with darkish indentation, and projecting slightly forwards, is a reddish margined membrane.

(*a*.)—Dull light brownish-umber, bright colours absent, specific marks brownish.

This species spins a web of normal form about buildings, on trees, etc.; fabricates its first cocoons in November, they have a broad-oval form, 3 mm. in diameter, greenish-brown, of a soft felty texture, suspended by fine lines, contain about 128 unagglutinated, spherical, straw-coloured eggs. Pairs about end of October.

Te Karaka, Auckland, *A.T.U.* Common in the district.

Theridium blatteus, sp. n. Plate VII., fig. 2.

Length of a mature female, $2\frac{1}{2}$ mm.

Cephalothorax broad-oval, moderately constricted at caput, which is prominent; median indentation transverse oval; it is glossy, greenish-yellow, suffused with dark olive; profile line rises abruptly from thoracic junction, dips into indentation, then forms a moderate arch across caput. *Clypeus* prominent, slopes forward, about half facial space.

Four central *eyes* form a square, anterior pair prominent, dark, and rather smaller than the rest, which are flatter, have a pearly lustre, and placed on lake-coloured eminences; hind-centrals are about as far from each other as they are from the hind-laterals next to them—a space equal to their diameter; laterals nearly contiguous, seated obliquely on small tubercles, fore-pair close to anterior-centrals.

Legs long, slender, 1, 4, 2, 3; clear yellowish-brown, black annulations; armature fine erect hairs, long bristles; superior tarsal claws, 1st pair, rather weak and straight, tip bent, seven comb-teeth increasing in length and strength; interior claw smaller than superior, moderately bent, one pointed tooth.

Palpi moderately long, resemble legs in colour and armature; palpal claw short, curved, 4 long comb-teeth, forming an even line with point of claw.

Falces vertical, slender, yellowish, suffused with dark-olive, fangs short.

Maxillæ broad, somewhat rounded on inner, and obliquely truncated on outer side, moderately inclined towards *labium*, which is rather broader than long, somewhat pointed.

Sternum broad-cordate; these parts are dark-brown.

Abdomen oviform, broad, pointed at spinners, projects over base of cephalothorax, very convex above; ground-colour pale-purple and yellowish tints, thickly marked with small purple spots; wide central and transverse black bands, margined with pale-yellow at their extremities, form a large cross-like figure; ventral surface black, few yellow spots, spinners short. *Vulva* prominent brownish circular eminence, orifice large.

Te Karaka, Auckland, *A.T.U.*

Theridium pumilio, sp. n. Plate VII., fig. 3.

Length of an adult female, $1\frac{3}{4}$–2 mm., and of an adult male, $1\frac{1}{4}$ mm.

Cephalothorax broad-oval; lateral marginal constrictions at caput moderate; clear pale stone-colour, rugæ scale-like; median band and lateral margins dark-olive; median indentation broad shield-shaped; contour of profile slight double arch; *clypeus* prominent, less than half facial space.

Four intermediate *eyes* are placed on oval black spots, and form a trapezoid longer than broad, whose shortest side is in front; fore-centrals dark, smallest of eight; space between hind-centrals—which, with side eyes, have a pearly lustre—is less than an eye's diameter, and the interval between each and the hind-lateral next to it more than an eye's breadth; laterals contiguous, seated obliquely on dark tubercular prominences, nearly their diameter from fore-centrals.

Legs long, slender, 1, 2, 4, 3; more transparent than cephalothorax; armature few dark hairs and strong erect bristles; superior tarsal claws, 1st pair, slightly curved from base, straightening at free end, tips bent; about 7 comb-teeth, increasing in length and strength; inferior claw smaller than superior, bent sharply downwards and outwards, apparently only one tooth.

Palpi long, slender, resemble legs in colour and armature; palpal claw like tarsal claw, 5 teeth.

Falces vertical, divergent, normal clear hue; double row of teeth, 3 outer strong.

Maxillæ somewhat oviform, apices and inner margins fringed with black hairs, inclined towards *labium*, which is broader than long, prominently everted, dark hue, pale apex.

Sternum broad-cordate, normal hue.

Abdomen oviform, convex above, yellowish, more or less mottled with various shades of reddish-brown—in some examples faint; three longitudinal olivaceous spotted lines converge from base to spinners; lateral margins and ventral surface marked with streaks of similar colour; in some examples dark marks on cephalothorax and abdomen nearly absent, and buff patch at posterior end of abdomen prominent. *Vulva* large, somewhat coniform, concave within, exterior rugose membrane has tints of tortoise-shell, with a pale median band terminating at margin in a pale amber-coloured spoon-shaped, short apophysis, directed backwards; orifice large, somewhat reniform; projecting from posterior margin of labia is a second spoon-shaped apophysis, longer and larger.

Male nearly equals female in length, *cephalothorax* broader, striæ more defined, lateral margins have pinkish eminences over each coxal joint. *Palpi* yellowish, humeral joint long, cubital and radial short, latter cup-shaped; digital joint broad-oviform, convex and hairy externally, convexities directed towards each other; palpal organs simple, series of reddish lobes, projecting beyond them on lower side is a pointed black process.

Abdomen somewhat diamond-shaped, yellowish, mottled with orange-red, buff patch at posterior end; series of olivaceous spots form median band; streaks and marks on lateral margins and ventral surface.

Mature examples, especially females, may generally be taken throughout the winter months. Until winter rains set in, these little spiders are often numerous about pastures and amongst low native vegetation in damp spots. They spin a fine horizontal web, with a small triangular mesh; one portion is drawn up to a stem or blade, beneath which the spider rests.

Te Karaka, Auckland, *A.T.U.*

Theridium calyciferum, sp. n. Pl. VII., fig. 4.

Length of an adult female, 4 mm.

Cephalothorax broad-oval, lateral marginal constrictions at caput moderate; rugulose, brownish-yellow; caput, median band and marginal zone brown; fovea large, somewhat oval; radial and caput striæ well-defined; contour of profile rises from thoracic junction at an angle of 45°, notched at median indentation, caput slightly arched; *clypeus* convex, in height rather less than half facial space.

Eyes about equal in size, seated on black spots; four centrals nearly form square, anterior pair furthest apart, dark; hind-pair are one eye's breadth from each other, and rather more than that space from fore-centrals; laterals nearly contiguous, placed obliquely on tubercles; more than their diameter from hind-centrals.

Legs long, slender, relative length, 1, 4, 2, 3 = 10, 7, 6, 5 mm.; yellowish, dark annuli at articulation of joints, except tarsal; femora spotted; armature hairs and numerous strong bristles, tarsi of hind pair furnished with, on under side, strong curved hairs; superior tarsal claws, 1st pair, moderately curved, tip bent, 7 teeth increasing in length and strength, 3 apical teeth, strong, in form resemble free end of claw, directed outwards; inferior claw smaller than superior, bent downwards, 1 tooth, point behind.

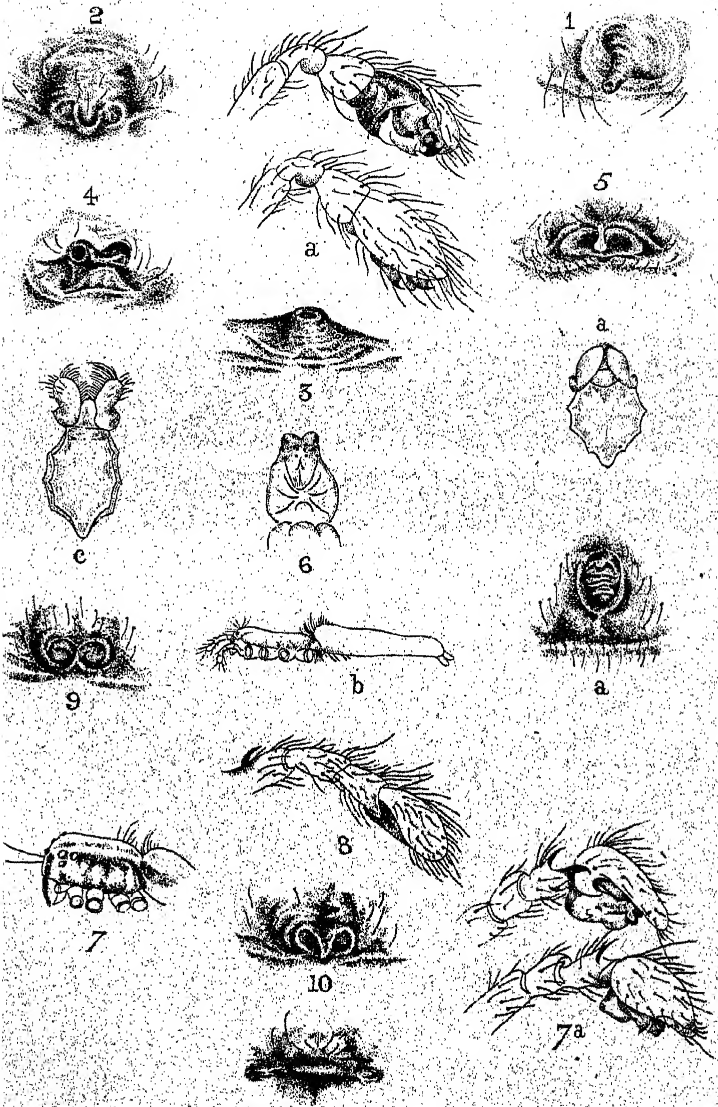
Palpi colour and armature of legs, palpal claw resembles tarsal claw, 6 teeth.

Falces convex, brownish-yellow, project a little forwards, one socket tooth.

Maxillæ somewhat spathulate, yellowish, inclined towards *labium*, which is broad, everted, nearly half length of maxillæ, greenish tinge.

Sternum heart-shaped, yellowish, margined and spotted with chocolate.

Abdomen elongate-oval, dorsal surface covered by a brown ovoid, leaf-like mark, median band strongly dentated, tapering



A.T.U. del.

NEW ZEALAND SPIDERS.

posteriorly, creamy color, brown marks; ventral surface light-brown. *Vulva* moderately prominent, circular, concave within, on posterior side are two black cone-like processes, apices directed backwards. Branchial opercula resemble yellowish cup-shaped calyces, acute apices directed towards genital organ.

Te Karaka, Auckland, *A.T.U.*

Theridium cruciferum, sp. n. Plate VII., fig. 5.

Length of an adult female 5 mm., of an adult male 4 mm.

Cephalothorax broad oval, slightly compressed before, glossy, light-brown; median band and marginal zone dark-brown; median indentation circular, striæ moderate; profile line rises from thoracic junction at an angle of 20°, then slopes across caput. *Clypeus* moderately prominent, in height about two-thirds depth of ocular area.

Eyes on dark spots, four central nearly form a square, anterior pair dark, seated on prominences; posterior pair rather more than their diameter apart, and closer to each other than each is to the hind-lateral next to it; laterals placed on tubercles, nearly contiguous.

Legs long, slender, 1, 4, 2, 3; first pair dark, ii., iii., iv., yellowish, speckled as far as tarsi, brown annuli at articulation of joints; furnished with few hairs and erect bristles; superior tarsal claws, 1st pair, 8 comb-teeth increasing in length and strength; inferior claw nearly equals superior in strength, 1 strong tooth.

Palpi pale yellow, slender, armature of legs; palpal claw 6 teeth, increasing in length and strength.

Falces conical, nearly vertical, chocolate-brown, few teeth.

Maxillæ long, somewhat roundly truncated on outer side, inclined towards *labium*, which is broader than long, rounded; these parts have a greenish-yellow tinge.

Sternum broad cordate, rugulose, stained round margins and spotted with purple-brown.

Abdomen oviform, convex, pointed at spinners; ground-colour olive-brown; on dorsal surface there is a large brownish-black, nearly ovate, indented leaf-like mark; on the fore part there is in some examples a well-defined cross, the base of which is creamy-white, margined with black, and directed forwards; remaining portions purple, picked out with whitish lines; between cross and spinners are several creamy spots throwing off oblique purple lines; lateral margins have several creamy, purple-spotted bands, and oblique dark bars; round spinners, and on ventral surface, are creamy purple-spotted marks. *Vulva* yellowish-brown, transversely wrinkled, oval eminence, concave within; projecting from anterior side, directed backwards, is a short tapering process, labia form; on posterior side, a dark, tumid, projecting lip, partially cleft in centre.

Male rather shorter than female, *cephalothorax* and *abdomen* more elongated, does not differ essentially in coloration or markings. *Legs* resemble female in colour and armature, but differ in their relative and actual length, 1, 4–2, 3, =13, 7½, 5 mm. *Palpi* rather long. slender, clear yellow-brown, sparsely furnished with coarse black hairs; humeral joint long, cubital and radial short, do not differ much in size, slender, cup-shaped; projecting from superior surface of former, are two strong, long bristles; digital joint oval, rugulose, mahogany colour; convex and hairy externally, convexities directed towards each other; concave beneath; palpal organs moderately complex; viewed from beneath, concavity at base is covered, for about one-fourth of length of joint, by a wide membranous band, little beyond transverse band, projecting forwards from margins of concavity are two short and stout apophyses; between these is a shield-shaped eminence, produced at its fore extremity into short, dark, horn-like processes.

Species common, frequents manuka; examples, male and female, differ greatly both in shades of coloration and distinctness of specific pattern; in yellowish or brownish-creamy specimens the cross-like figure is more or less obliterated, and devoid of lake markings. Pairs about November.

Auckland, *A.T.U.*

Theridium triloris, sp. n. Pl. VIII., fig. 1.

Length of an adult female 5 mm., and of an adult male 4 mm.

Cephalothorax oval, bright mahogany-brown; lateral marginal constrictions at caput moderate; median indentation, which is somewhat circular, and radial striæ well marked; profile rises with a slight arch to occiput, forepart of which is prominent; *clypeus* moderately prominent, in height equals half facial space.

Eyes form two transverse curved rows, convexity of curves directed forwards, hind-curve slight; eyes placed on dark spots; four intermediate form a quadrilateral figure, longer than broad; anterior centrals darkest and rather smallest of eight; interval between hind pair equals their diameter; laterals, which are seated obliquely on dark tubercles, one quarter of their breadth apart, are rather further from hind-centrals than the latter are from each other.

Legs rather short, relative length 1, 4, 2, 3; yellow-brown, dark greenish annuli at articulations; armature erect hairs, few bristles; superior tarsal claws, 1st pair, moderately strong, curved, 9 comb-teeth increasing in length and strength; inferior claw rather stout, bent, 2 close teeth, basal small.

Palpi resemble legs in colour and armature; palpal claw strong, curved, 7 comb-teeth directed forwards, forming an even line with point of claw.

Falces prominent at base, vertical; light red-mahogany colour; one strong tooth near extremity.

Maxillæ obliquely truncated on outer side, inclined towards *labium*, which is somewhat oval, more than half length of maxillæ, everted; these parts have a brownish tint, labium darkest.

Sternum broad cordate, rugulose, chocolate-brown.

Abdomen oval, moderately convex above, projects over base of cephalothorax; brownish-black, sparingly clothed with fine light hairs; encircled and centrally divided with creamy-coloured disjointed bands; marginal bands extend from spinners along ventral surface to branchial opercula. *Genital* organ vermiform, pendulous, directed backwards; pale amber-colour, extremity reddish; projects from much wrinkled integument of a darker hue.

Male shorter and slimmer than female, resembles her in specific pattern, colour, and armature; caput rises higher, projects further forwards, causing hind and especially the fore-row of *eyes* to form a stronger curve.

Legs rather longer than female's, i.–iv., ii.–iii., nearly equal, strong black hairs.

Palpi mahogany-colour; humeral joint long; cubital and radial short, latter cup-shaped, greenish; digital joint oval, convex, and hairy externally, convexities directed towards each other; palpal organs moderately complex, lobe-like, posterior half dark; projecting at extremity is a broad black, concave, sharply pointed process.

Taken on shrubs; cocoons two or more, whitish, globular, 4 mm. in diameter, suspended by a short silken line to inferior surface of leaf; about 15 light-coloured spherical eggs, not agglutinated together; web normal intricate lines. Pairs in November.

Te Karaka, Auckland, *A.T.U.*

Theridium squalide, sp. n. Plate VIII., fig. 2.

Length of an adult female, 5 mm.

Cephalothorax oval, moderately compressed at caput, glossy red-mahogany; median fovea narrow-oval, deep, nearly length of thorax; caput and radial striæ well-marked; contour of profile rises gradually from thoracic junction, forming a slight arch across caput; *clypeus* vertical, convex, indentation below eyes; height equals depth of ocular area.

Four central *eyes* form a trapezoid whose shortest side is between anterior pair, which are smallest of eight; posterior pair less than their diameter apart, rather more than their breadth from hind-laterals; posterior centrals and side eyes have a pearl-grey lustre, latter largest of eight, close, placed obliquely on moderate tubercles.

Legs moderately long and slender; 4, 1, 2, 3, iv. pair slightly exceeds i. in length; colour yellowish-amber; armature erect black hairs, few fine bristles; superior tarsal claws, 1st pair, moderately strong and curved, 7 rather short close teeth, increasing in length; inferior claw smaller than superior, bent downwards and forwards, two teeth, basal shortest and stoutest.

Palpi rather long and slender, resemble legs in colour and armature, strong hairs on digital joint; palpal claw rather weak, 5 or 6 short teeth.

Falces prominent at base, vertical, divergent, rugulose, bright red-mahogany, 3 strong teeth.

Maxillæ long, linear, somewhat rounded, with lip-like indentation at apex (apparently caused through pressure of fangs), inclined towards *labium*, which is broader than long, everted; these parts have a bright red-mahogany colour.

Sternum cordate, pitted, dull mahogany-colour.

Abdomen ovoid, yellowish-brown, clothed with light hairs. *Vulva* yellowish brown, transversely wrinkled, somewhat oblong, convex eminence, concave within, projecting posteriorly from anterior side there is a yellowish amber-coloured protuberant lip, with incurved margins.

Te Karaka, Auckland, *A.T.U.*

Theridium setiger, sp. n. Plate VIII., fig. 3.

Length of a mature female, 3 mm.

Cephalothorax oval, moderately constricted forwards, caput prominent in front; rugulose, glossy brown-black; median indentation semicircular, convexity directed backwards; normal grooves moderate; profile contour forms a slight arch across caput, roundly curved posteriorly; *clypeus* projects prominently forwards, pointed; indentation below eyes, in height nearly equals depth of ocular area.

Eyes large, four centrals form a square; anterior pair dark, placed somewhat obliquely on angular projections; posterior row, rather less than their diameter apart, form a slight curve, convexity of curve directed backwards; lateral eyes, which have the pearly lustre of hind-centrals, are contiguous, and seated obliquely on reddish-brown tubercles, space between them and fore-centrals rather less than interval between latter pair.

Legs moderately long and strong, relative length, 1, 4, 2, 3; i. longest, ii. nearly equals iv.; pellucid-grey, well-defined black-brown annulations; armature strong hairs, few bristles. Superior tarsal claws, 1st pair, moderately curved, 7 comb-teeth, increasing in length and strength; inferior claw fine, bent, apparently no teeth.

Palpi resemble legs in colour and armature, palpal claw strong, curved, 5 long comb-teeth forming an even line with point of claw.

Falces tapering, project slightly forwards, reddish-brown.

Maxillæ acute oval, inclined towards *lip*, which is nearly twice as broad as long; everted, one-third length of maxillæ.

Sternum broad cordate; these parts are chocolate-brown, rugulose.

Abdomen broad oval, strongly convex above, rises somewhat abruptly from thoracic junction; sparingly clothed with strong erect hairs and bristles; ground colour greenish-brown, slightly suffused with dull-pink, mottled with brown-black; median band faint, tapers towards spinners, black marks at base; on lateral margins are four oblique brown-black bars, streaked on posterior side with pink, converge towards spinners, which are short. *Vulva* somewhat conical, reddish-black, prominent eminence, orifice circular, large.

Te Karaka, Auckland, *A.T.U.*

Theridium zantholabio, sp. n. Plate VIII., fig. 4.

Length of an adult female, 4 mm.

Cephalothorax broad oval, constricted anteriorly; light amber-colour; median band brown, lateral margins faintly mottled with a similar hue; median indentation broad, U-shaped, large, moderately depressed; contour of profile rises at an angle of 40°, then slopes slightly to ocular area; *clypeus* prominent, in height about half facial space.

Four intermediate *eyes* form square, anterior pair dark; posterior pair less than their diameter apart, about that space from side-eyes, which are smallest of eight, contiguous, placed obliquely on small tubercles.

Legs moderately long and slender, relative length 1, 4, 2, 3; have hue of cephalothorax, rather faint brown annulations; armature dark hairs and erect bristles; superior tarsal claws, 1st pair, curved, 5 long comb-teeth; inferior claw moderately strong, free and fine, bent, 1 tooth, small point behind.

Palpi resemble legs in colour and armature, palpal claw curved, 7 long comb-teeth, forming an even line with point of claw.

Falces project slightly forwards, moderately slender, dark amber-colour, about 3 blunt teeth.

Maxillæ long, linear, roundly truncated on outer side, moderately inclined towards *labium*, which is nearly twice as long as broad, somewhat pointed; these parts have a reddish-amber hue, suffused with brown.

Sternum cordate, yellowish, margined with chocolate.

Abdomen oviform, convex above, yellowish-brown, suffused with dull pink; a broad, somewhat spathulate, irregularly pinnatifid median band, dark brown at basal end, lighter and spotted at truncated apex, extends two-thirds across the abdomen; lateral margins spotted and streaked; transverse

dark bands on ventral surface. Anterior portion of *vulva* consists of a reddish-black oblong, transverse, tapering eminence, circular fovea at either end, projecting upwards; on posterior side is a large, broad, clear yellow incurved lip.

Web consists of irregular lines; cocoons ovoid, yellowish-brown, undulations shaded with brown, loose felty texture; contain about 40 pale straw-coloured spherical eggs, not agglutinated together, but wrapped in a second delicate soft silky cocoon.

Taken in March; Cliffs, North Shore, Auckland, *A.T.U.*

Theridium sericum, sp. n. Pl. VIII., fig. 5.

Length of a mature female 9 mm., and of immature male 5 mm.

Cephalothorax broad-oval, glossy, yellowish-brown, moderately constricted in front; median fovea circular, radial and caput striæ moderately marked; contour of profile rises at an angle of 45° from thoracic junction to verge of median indentation, then slopes across caput. *Clypeus* convex, prominent, in height more than half facial space.

Eyes disposed in two transverse curved rows, forming a narrow oval space; four intermediate eyes nearly form a square; anterior pair darkest and rather smallest of eight; posterior pair rather less than their diameter apart, and more than that interval between them and lateral eyes next to them; side eyes contiguous, placed obliquely on small black tubercles, have the pearly lustre of hind-centrals.

Legs moderately long and strong, 1, 4, 2, 3 = 18, 15, 14, 10 mm.; reddish-brown; armature fine dark hairs and slender bristles; superior tarsal claws, 1st pair, moderately curved, free and thickening a little, tip bent inwards, 7 comb-teeth rapidly increasing in length and strength, strong teeth have somewhat the form of free end, directed forwards; inferior claw sharply bent, 2 teeth differing in size, close together.

Palpi resemble legs in colour and armature, palpal claw resembles superior tarsal claw, 7 teeth.

Falces convex, tapering, directed moderately forwards, few teeth, bright light-mahogany colour.

Maxillæ long, pointed, much inclined towards labium, which is somewhat oval, apex truncated, less than half length of maxillæ; these organs have a reddish-brown hue, apices light.

Sternum broad cordate, yellowish-brown, few dark hairs.

Abdomen oviform, convex above; chocolate-colour, series of four or five creamy-brown angular bars on dorsal surface, few fine dark hairs, abdomen has a soft silky lustre. *Vulva* on anterior side forms a low wrinkled, membranous arched hood, centrally produced into a yellowish spathulate process, directed backwards; moderately concave within, yellowish; oblong olivaceous mark in centre.

Male smaller than female, resembles her in form, markings, and colour. *Legs*, relative length, 1, 4, 2, 3 = 11, 9, 8½, 7 mm.

Some examples of this species are of a very dark brown-chocolate colour, specific pattern faint. These spiders are not uncommon in buildings, and under bags; mature examples may be taken throughout the winter months. Their webs are formed of fine lines, with a silky lustre, intersecting one another in various planes and at different angles. Cocoons are fabricated from about December to May, resemble loose balls, 10 mm. in diameter, of soft white wool; are suspended by a few short lines, generally close to the walls or roof, visible within are about 88–120 whitish spherical eggs, not agglutinated together.

Te Karaka, Auckland, *A.T.U.*

Fam. THOMISIDÆ.

Sub.-Fam. PHILODROMINÆ.

Genus **Hemiclæa,** Thorell.

Hemiclæa plautus,* sp. n. Plate VIII., fig. 6.

Length of an adult female, 13–15 mm.

Cephalothorax oval, very depressed, one-fourth longer than broad, moderately constricted forwards; mahogany-colour, glossy, rugose; sparsely clothed with light-yellowish pubescence, few interspersed fine plumose hairs, and erect black hairs, mostly about lateral margins. Caput relatively wide, squarely truncated, three depressions on median line, two anterior foveæ circular; basal depression forms with thoracic indentation a fiddle-like mark; caput and radial striæ distinct. Contour of profile level. *Clypeus* projects sensibly forwards, in height less than diameter of a fore-central eye.

Eyes small; posterior row slightly curved, convexity of curve directed forwards; median eyes smallest of eight, flat, and rather closer to one another than each is to the lateral eye next to it; anterior row shortest, straight; intermediate eyes, which are largest of eight, rather more than their radius apart, and about twice that interval from fore-laterals, form with hind-centrals a trapezoid whose anterior side is shortest; space between fore and hind intermediate eyes more than diameter of a fore-central; interval between laterals, which are seated on slight eminences, nearly equals space between hind-laterals and hind-centrals.

Relative length of *legs* 4–2, 3–1 = 23, 18 mm.; in some

* Since this paper was read, through the courtesy of P. Goyen, Esq., of Dunedin, I received a brief description of Koch's *H. rogenhaferi*, to which *H. plautus* bears so close resemblance that it may not retain specific rank.

examples 4, 2, 3, 1; yellowish or reddish-brown, sparsely furnished with fine erect hairs; 1 or 2 spine-like bristles on femora, upper side; i.–ii. pair rather stoutest; 2 spines at base of metatarsi; tibiæ of ii. pair 1 spine; tibiæ of iii.–iv., 3 spines; metatarsi, 5 spines; exinguinal joint of iv. longest. Tarsal claws, 1st pair, coarse, slightly sinuated, free, and curved into a hook; inner claw, 15 teeth; basal end has 12 long fine comb-teeth increasing in length, 3 coarse at extremity of row, curving backward; outer claw 12 sparse teeth, increasing greatly in length and strength, curving backwards; 4th pair, inner claw, 10 teeth increasing greatly in length, 4 terminal teeth sparse; outer, 8 coarse open teeth. The number of teeth on the claws differ in different individuals. Probably the maximum number are given in the described example. Claw-tuft and scapula hairs moderately long, fine, terminal half linearly incrassated, serrated; latter hairs extend to base of matatarsi on i.–ii. pairs.

Palpi like legs in colour, strong; long black hairs, spine on humeral joint; digital joint densely clothed with short hairs, 2 long spines beneath palpal claw, which is fine, curved, about 5 teeth.

Falces strong, conical, very gibbous, base projects forwards, apices outwards; glossy, reddish-black; fang long, fine.

Maxillæ tumid at base, fore-half linear, rounded at apex, directed outwards; strong hairs on inner margin.

Labium conical, roundly truncated, more than half length of maxillæ, attached to a broad, projecting, collar-like process; these organs have a reddish-brown colour.

Sternum oval, or somewhat vase-shaped, owing to neck-like development of fore-part; brownish.

Abdomen elongate-oval, squarely truncated at base; very depressed; colour, graduated tints of light slate and yellow-stone, latter tint predominant on dorsal and ventral surfaces; sparsely clothed with yellowish pubescence, fine plumose hairs, and coarse black hairs; impressed spots prominent; spinners moderately long. *Vulva* large; anterior portion consists of a reddish-black oval, slightly concave, transversely wrinkled eminence, integument on either side towards posterior end swells out into somewhat pear-shaped protuberances, olive-green, or glossy red-brown.

The colouration and remarkably depressed form of this species indicates its natural haunts; mature examples may be found throughout the year under exfoliate bark, etc.; movements rapid. Cocoon constructed in crevices, oval, lenticular, 2 to 3 metres long, composed of soft, close, white silk, attached by its inferior surface, contains about 60 pale-coloured eggs, not adherent among themselves.

Dunedin, *P. Goyen*; Auckland, *A.T.U.*

Fam. LYCOSIDÆ.

Genus **Lycosa**, Latr.

Lycosa proxima, sp. n. Plate VIII., fig. 7.

Length of a mature male or female, $2\frac{1}{3}$ mm.

Cephalothorax oval, slightly constricted in front; somewhat transversely rugose; light yellowish-brown, light and coarse dark hairs; two wide olivaceous bands extend from posterior eyes to base of thorax; faint, somewhat depressed, brown line along dorsal surface; profile line rises from thoracic junction at an angle of 65°, horizontal as far as third row of eyes, then dips rather abruptly. *Clypeus* directed moderately forwards, in height rather more than space between fore-central eyes; olivaceous bands extend from latter eyes to margin.

Anterior row of *eyes* smallest of eight, curved; intermediate pair slightly the largest, black, rather more than their diameter apart, and nearly twice that space from exterior eyes of same row, which have a reddish-pearly lustre, placed on dark collars; eyes of second and third rows have a reddish hue, seated on reddish lake-coloured tubercles; second row shorter than first, third about equal.

Legs moderately long and slender, nearly equal in length, apparently 4, 1, 2, 3; light yellowish-brown; armature dark hairs, numerous long erect spines; superior tarsal claws, 1st pair, curved, free, and directed somewhat forwards, about 9 small comb-teeth, increasing slightly in length, pointing forwards; inferior claw short, sharply bent, apparently no teeth.

Palpi moderately long, resemble legs in colour and armature; humeral joint stout, two long erect spines on upper side, rather exceeds cubital and radial joints in length, latter articles about equal in size, somewhat cup-shaped, furnished with strong bristles; projecting upwards from fore-part of radial joint is a stout spine, and a short, broad, curved, dark process, upper margin of which is furnished with a row of short comb-like teeth, is produced on outer side at its articulation with the digital joint, which is oviform, partially cleft at tapering apex, convex, and moderately hairy externally; basal end of inferior surface somewhat bulb-like; fore lobes terminate at apex with short, dark, serrated, membranous projections.

Falces conical, directed slightly inwards; fangs short; normal hue; olivaceous streaks on frontal margin are continued along entire length of falces.

Maxillæ enlarged at apex, about as broad as long, somewhat roundly truncated on inner side, normal yellow-brown hue.

Labium short, somewhat oval, dark.

Sternum heart-shaped, brownish.

Abdomen oviform, widest towards posterior end, yellowish-brown, clothed with light hairs; two wide olivaceous bands

extend from base to spinners, apparently an extension of bands on cephalothorax. A broad band extends across ventral surface, covered with prominent brownish papillæ.

Female does not differ essentially from male, either in size, specific pattern, or colouration. *Palpi* resemble legs in colour, armed with strong bristles; palpal claw fine, long, straight, no teeth. Papillæ absent on ventral surface of abdomen.

These interesting little spiders were captured on manuka; bear a close resemblance both in colouration and form to a rather common species of *Oxyopes* (*O. gregarius*), which, in following Blackwall, was assigned in my former paper to the genus *Sphasus*, Walck.

Te Karaka, Auckland, *A.T.U.*

Fam. ATTIDÆ.

Genus **Attus**, Walck.

Attus auricomus, sp. n. Pl. VIII., fig. 8.

Length of an adult female 7 mm., and of an adult male 7½ mm.

Cephalothorax one-third longer than broad, widest at fore part of caput; red-mahogany colour, suffused with dark-brown, sparingly clothed with pale-yellow, golden-orange lanceolate, and strong black erect hairs; median fovea large, shallow, nearly circular; ocular area more than one-third of cephalothorax; profile line rises from thoracic junction at an angle of 45°, runs horizontally as far as posterior lateral eyes, then slopes moderately across caput, which is prominent in front. *Clypeus* directed inwards, very narrow, furnished with few white hairs.

Space between posterior lateral *eyes* rather more than interval between them and anterior laterals, latter pair furthest apart, and form with fore-centrals a slightly curved transverse row; anterior row half the diameter of a fore-lateral eye apart.

Legs moderately strong, relative length 1–4, 2, 3; fore-pair reddish hue, suffused with chocolate-brown, hind pairs pale yellow-brown; general joint nearly equals tibial in length, metatarsi rather longer than tarsi; armature short and long fine hairs, 3 spines on upper side of femora, normal number on tibiæ and metatarsi, spines on latter remarkably long; tarsal claws sinuated, long; 1st pair, outer claw 1 strong curved tooth, near centre; inner claw 11 teeth, 10 short, 1 long, curved tooth; 4th pair, outer claw 17 teeth, 16 small close, 1 strong tooth; inner claw 10 teeth, 9 open comb-teeth, 1 strong tooth; hairs of claw-tuft gradually dilated, upright, spreading.

Palpi moderately long, brown, black and white hairs, short curved spine at end of humeral joint.

Falces short, broad, flat, rugose, bright red-mahogany colour.

Maxillæ long, spathulate, red-mahogany hue, apices pale.

Labium rather less than half length of maxillæ, dark-brown, apex round, everted, pale.

Sternum oval, yellowish-brown.

Abdomen elongate-oviform, projects over base of cephalothorax; brown, clothed with bright yellow and erect black hairs; median band, broad-lanceolate, margined with dark-brown, on the basal half there are a series of angular brown marks, apices directed forwards; between latter and spinners, which are long, there is a tapering brown mark; ventral surface light-brown, two dark lines converge posteriorly from bronchial opercula.

Genital eminence moderately prominent, convex above, concave within, orifice oval, projecting from above is a tapering process directed backwards.

Male slightly exceeds female in length, resembles her in form and colouring, specific pattern more defined; median band of cephalothorax formed of yellow and bright orange-red lanceolate hairs, in some examples nearly covering ocular area, tapering towards and bifurcating at thoracic junction; marginal zone fringed with yellow hairs. Anterior *eyes*, like those of females, are encircled with an iris of golden orange-red hairs. *Clypeus* thickly bearded with short pale-yellow hairs.

Legs differ from female's in relative, 1, 2, 4, 3, and exceed hers in actual length; first pair red-mahogany colour, suffused with brown, hind pairs pale-brown, darker and faintly annulated towards extremities; outer tarsal claw, 1st pair, 1 strong curved tooth near centre; inner claw 19 teeth, 18 small, close teeth, increasing slightly in length, terminal tooth long, curved.

Palpi moderately long, strong black hairs; humeral joint greenish-brown, projects a short, curved black spine on upper side near its articulation with cubital joint; humeral rather exceeds cubital and radial joints in length, the latter is one-third shorter than cubital; a black curved, horn-like apophysis projects on outer side, at articulation with digital joint, which is a rather narrow oval, has red-mahogany hue of former joints, convex above, convexities directed towards each other; palpal organs simple, inferior surface somewhat pointed bulb, a reddish beaded band extends from base beneath upper fold, curving upwards near apex.

Captured in June beneath old bags, Te Karaka, Auckland, *A.T.U.*

Attus zanthofrontalis. Plate VIII., fig. 9.

Salticus zanthofrontalis, A.T.Ur. "Trans. N.Z. Inst.," 1884.

Length of an adult female, 4–5 mm.

Female does not differ much from male, abdomen larger, first pair of legs shorter, relative length 1–4, 2–3; femora, 1st pair, tumid, genua and tibiæ strong, nearly equal in length, metatarsi about two-thirds length of tibiæ, tarsi rather shorter; tarsal

claws moderately strong, curved, inner claw has 7 small close teeth, outer none; hairs of claw-tuft somewhat spathulate.

Palpi resemble legs in colour, armed with hairs and bristles.

Vulva convex, orifice transverse oval, margin of hood, or labrum, produced into a short pointed process, directed backwards; labium prolonged into a reddish pointed process, directed forwards, longer than upper process.

Var. *hirta.*, nov.

This variety is more thickly clothed with hairs, especially in *female* examples. *Cephalothorax* brown-black, covered with yellowish and erect black hairs, white patch usually behind posterior lateral eyes. *Abdomen* clothed with similar hairs; series of white, somewhat angular marks, apices directed forwards, extend along median line; white oblique streaks on lateral margins. Dorsal marks on *males*, which are less hairy, take the form of spots. *Legs*, more especially in male examples, furnished with numerous long flexible erect hairs.

Both forms numerous about sunny clay slopes. Te Karaka, Auckland, *A.T.U.*

Attus saxatilis, sp. n. Pl. VIII., fig. 10.

Length of an adult female, 5–6 mm.

Cephalothorax rather longer than broad, rounded posteriorly, sides abrupt, glossy dark-brown, caput lighter; coarse black hairs about ocular area; median fovea large but shallow; contour of profile rises at an angle of 45°, then slopes across caput, which is moderately prominent in front. *Clypeus* furnished with long white hairs directed centrally, in height less than diameter of a fore-lateral eye.

Ocular area occupies rather more than one-third of cephalothorax, broader than long; anterior row of *eyes* sensibly curved, slightly parted, laterals nearly half their diameter from intermediate pair, posterior laterals form a transverse line with fovea, are rather smaller than anterior laterals, interval between them rather less than that between the latter pair; irides encircling fore-row whitish; small laterals equidistant between fore and hind-laterals.

Legs short, slight, relative length 4–3, 1–2; yellowish-brown; armature hairs, spines normal; tarsal claws, 1st pair, sharply curved, about 13 short, close teeth on inner claw, 2 coarse teeth on outer; claw-tuft strong, hairs linear.

Palpi yellowish-brown, long light hairs.

Falces short, vertical, greenish-brown, fangs short.

Maxillæ as broad as long, truncated on inner side; pale straw-colour, slightly suffused with olive-green.

Labium broad-oval, nearly half length of maxillæ, similar tints.

Sternum oval, black, light hairs.

Abdomen ovoid, slightly longer than cephalothorax, brown-black, sparingly furnished with short light hairs. *Vulva* moderately prominent, convex; margin of hood forms a transverse, lightish brown intumescent lip, extending to branchial opercula.

Shingle slopes, Two-Thumb Range, Lake Tekapo, Canterbury, *A.T.U.*

EXPLANATION OF PLATES VI.-VIII.

PLATE VI.

Fig. 1. *Linyphia diloris*, sp. n., *a*, male; *b*, female; three times natural size; *c*, palpus of male in two positions; *d*, vulva; *e*, claws of fore-leg and maxillæ, labium of female.

Fig. 2. *Linyphia trisphathulata*, sp. n., male and female; five times natural size; *a*, palpus of male in two positions; *b*, vulva.

Fig. 3. *Theridium varium*, sp. n.; *a*, male; *b*, female; twice natural size; *c*, palpus of male in two positions; *d*, claws of first part of legs; *e*, vulva.

PLATE VII.

Fig. 1. *Theridium veruculatum*, sp. n., female; four times natural size; *a*, vulva.

Fig. 2. *Theridium blatteus*, sp. n., female; seven times natural size; *a*, vulva.

Fig. 3. *Theridium pumilo*, sp. n.; *a*, male; *b*, female; eight times natural size; *c*, palpus of male; *d*, maxillæ, labium, and sternum of female; *e*, vulva; *f*, claws of anterior leg.

Fig. 4. *Theridium calyciferum*, sp. n., female; four times natural size; *a*, vulva.

Fig. 5. *Theridium cruciferum*, sp. n., female; four times natural size; *a*, vulva.

PLATE VIII.

Fig. 1. *Theridium triloris*, sp. n., vulva; *a*, palpus of male in two positions.

Fig. 2. *Theridium squalida*, sp. n., vulva.

Fig. 3. *Theridium setiger*, sp. n., vulva.

Fig. 4. *Theridium zantholabio*, sp. n., vulva.

Fig. 5. *Theridium sericum*, sp. n., vulva; *a*, maxillæ, labium, and sternum.

Fig. 6. *Hemiclæa plautus*, sp. n., cephalothorax of female; *a*, profile with legs truncated, twice natural size; *b*, vulva; *c*, maxillæ, labium, and sternum.

Fig. 7. *Lycosa proxima*, sp. n., profile of cephalothorax with legs and palpi truncated; 7*a*, palpus in two positions.

Fig. 8. *Attus auricomus*, sp. n., palpus of male and vulva.

Fig. 9. *Attus zanthofrontalis*, vulva.

Fig. 10. *Attus saxatilis*, sp. n., vulva.

ART. XXXVIII.—*Description of* Diadema nerina.

By R. J. KINGSLEY.

[*Read before the Nelson Philosophical Society, 13th April, 1885.*]

OF the Order Lepidoptera, New Zealand appears to possess but a comparatively few species, especially when we consider how lavish nature has been in this respect in both number and

beauty with Australia and the adjacent islands, and America; even Britain is far better off in variety than this colony. Of the few we can boast of, the specimen which I have the pleasure to exhibit is, I believe, one of the largest and most beautiful.

It was caught in a garden, near the Normanby Bridge, on the 18th of last March, and is the only specimen I have hitherto met with.

In vol. ix. of the Transactions I believe there is a notice of the capture of the only other female specimen recorded; it was captured by Thomas Tanner, Esq., of Hawke's Bay.

The male has been several times met with, but still not frequent, since the Rev. Richard Taylor, of Wanganui, states he only observed two in a period of thirty-two years. Dr. Barker also saw one in a garden at Christchurch.

I have affixed the name *Diadema nerina* to this specimen, but I am not absolutely certain whether it may not be a distinct variety, inasmuch as it does not quite coincide with the description of this species given in Mr. Enys' book "On the Butterflies of New Zealand," published in Christchurch in 1880.

From that work (which I may state is a reprint from vol. x. of the Transactions,) I gather: "The range of this species is peculiar; it occurs in Java, Australia, New Guinea, and the Loyalty Islands, and a small variety in Samoa."

Dr. Semper, in his work, says:—"In Samoa the larva lives long after it is adult, and then becomes a pupa very abruptly. The pupæ hang suspended everywhere on trees, old stones, etc., and change after twelve days. Breed in November. It is very probable that the habits of *Diadema nerina* would be very similar to that of Samoa."

From this extract it will be seen that this species forms another of the interesting links that exist amongst the fauna of New Zealand, and that of Australia and adjacent islands, each in their way helping to establish the theory advanced by geologists, of these countries, with New Zealand, having in past ages formed one vast continent.

I give my own description of the specimen now before you.

Order LEPIDOPTERA.

Section RHOPALOCERA.

Sub-family Nymphalinæ.

Species *Diadema nerina.*

Description—Female.—Above black-brown, fringes white, varied; primaries with tawny-red patch extending from the internal border towards the discoidal vein. An oblique whitish band beyond the cell, divided into four elongated spots bordered with a bluish tinge. A double sub-apical whitish spot anterior margin blue tinged, from which extend a series of three small

round blue-edged white spots across the disc towards the oblique whitish band, beyond which they are continued by two small round blue spots to the external margin of the tawny patch; between the oblique band and the tawny patch there is a rather faintly marked blue spot. A double sub-marginal series of interrupted lunulated bluish spots.

Secondaries crossed by a broad whitish patch bordered with blue; a sub-marginal series of spots as in the primaries, but more indistinct; the series of round spots also continued as rather faint blue spots.

Body above blackish-brown; head and pro-thorax white spotted; white vertical dash at back of each eye.

Wings below, red-brown; basal area of primaries ferrugineous; basal half of costa black, spotted with white; four black-edged, sub-costal white spots, oblique patch of black brown across disc to middle of costal area; oblique band of five white spots as on the upper side, the extra spot being on the costal area. A double, sub-apical, whitish spot, with series of small spots as on upper, the two blue ones being larger but more faint, a double sub-marginal series of lunulated whitish spots, fringe white, varied.

Secondaries below, a diffused central transverse whitish band; a discal series of white spots, and a double series of lunulated whitish spots; body below red-brown, spotted with white; palpi and inner edge of femora, white; expanse of wings, 4½ inches.

In comparing this description with that in Mr. Enys' book, there are the following differences:—

On the primaries, he gives *five* elongated *white* spots, this has but four, and bordered with blue tinge; he gives a sub-apical *white* spot; this has a *double* white *blue-edged* spot; his a series of white spots; this *two* of the series unmistakeably *blue*, and a blue spot near the tawny patch; his lunulated spots were *white*, these decidedly *bluish*.

On the secondaries, his large spot is edged with either tawny or blue; his diagram shows tawny; this is edged with a *brilliant blue*.

He says nothing of the discal series of blue spots.

Below, he does not mention the oblique band of black-brown, but gives the costal base and anal area as ferruginous, which I fail to observe.

His measurement is 3 inches 9 lines; mine, 4·5 inches.

With regard to the rare occurrence of this species, as well as the *Vanessa antiopa*, or Camberwell Beauty of the British Isles (the latter only observed at regular periods of seven years), I have long had a supposition that the larva of these butterflies may very probably take a much longer period to arrive at maturity, say five or six years; if so, this would fully account

for their only being observed at regular fixed periods. When we are more conversant with the details of the lives of these insects through their different stages of existence, we shall, doubtless, be in a position to give an easy solution to many of the problems that puzzle us now.

Art. XXXIX.—*Life History of* Epyaxa rosearia, *Dbld.*

By A. Purdie, M.A.

[*Read before the Wellington Philosophical Society, 23rd September*, 1885.]

The object of this short paper is to describe the life history of the above moth, and also to correct some errors in Mr. Meyrick's description of the adult insect. These errors are not the result of inaccurate observation, but of having bad specimens. This moth, although not distinguished by bright colouring, is interesting, as being one of those species in which the male and female differ much in colour. So much do they differ, that in the case of most, if not of all, these species the male and female were at first described as distinct species; but this is not so remarkable, for one of these authors has given as many as ten different names to one species.

Taking now the three stages of this insect:

The egg is oval, smooth, and of a pale yellow colour.

The caterpillar is a looper—that is, it has pro-legs only on the 10th and 13th segments; and two specimens of it were found about the 1st of August, nearly full-grown, on water-cress in the mouth of an old mining tunnel near the Waterworks.

Description of caterpillar.—Length, at rest, about three-quarters of an inch. Colour light-green, with indistinct whitish longitudinal lines, and a narrow median dorsal stripe of the ground colour, edged on each side by one of these whitish lines; a subdorsal whitish line on each side of the median stripe; the ground colour shows again as a lateral line, edged below with whitish. Under-side with delicate whitish or yellowish longitudinal tracings, as on the upper side. The junctions of the segments show yellowish or whitish rings when the larva contracts.

Head, greenish-yellow. Body tapering somewhat to the head.

Chrysalis enclosed among the withered leaves of the cress above ground; very dark brownish-black, glossy.

A pair of the perfect insects emerged about the second week of September. Mr. Meyrick's descriptions are evidently taken from more or less faded cabinet specimens: hence there are errors unavoidable in the case of a naturalist not having access

to fresh specimens. In specimens kept for some time the male is, as he describes, pale whitish-grey, with the median band of the forewings more or less distinctly outlined with black, especially opposite the cell; while the female is ochreous or of a pale sandy colour, with faint traces of the usual markings.

But in quite fresh specimens the insects are much more ornamental. The male is darker than above described, usually of a rosy or warm-tinted grey as ground colour in the forewings. The outer side of the basal patch and both sides of the median band are edged with a greenish-yellow line, showing distinctly on the unfaded ground-colour. The fringes are also rosy-grey. Mr. Meyrick states that the male is very constant in colour and the female variable; but the reverse is rather the case, faulty specimens having led to this misstatement, for the female suffers most when preserved in a cabinet. The true colour of the forewings of the female is dull yellowish-green; but the common methods of killing—for instance, by bruised laurel leaves—destroy the colouring of green moths. Collectors may note this caution against exposing fine green moths to the fumes of prussic acid. By lantern light the female seems to be of a glaucous or peculiar blueish green, which serves at once to distinguish it. The green colour of the female seems dingy and faded if placed beside the rich green of *Cidaria similata*, but if compared with the dull greys of allied *Geometrina* it seems peculiar and noticeable. The ordinary markings are not very distinct in the female. The hindwings are often a dull blackish-grey. The yellowish colour ascribed to the female is merely the common colour of faded green moths. The two sexes are more dissimilar in their fresh state than when faded; and the green colour of the female may serve as a very efficient protection whilst among foliage.

ART. XL.—*Notes on the so-called "Vegetable Caterpillar" of New Zealand.*

By A. HAMILTON, of Petane.

[*Read before the Hawke's Bay Philosophical Institute*, 1885.]

AMONG the many curious and interesting objects of natural history which have been made known by the collections of the early travellers and voyagers to our Southern seas, very few surpass in general interest the subjects of these notes. The evident vegetable nature of the one part, and the simulacrum of the perfect caterpillar of the other part, presented a biological riddle of the deepest interest, and one which we are yet very far from having solved fully.

At first sight, one might well be pardoned for considering a "vegetable caterpillar" as a specimen of the "mermaid class," cleverly constructed by some ingenious hand, in the same way as the naturalist Waterton prepared his "nondescripts" for his museum; but, more closely examined, Nature triumphs, and not only so, but by the variety of ways in which she effects the same end, illustrates anew the axiom that no two things are exactly similar. For a long time I thought that there was but one simple form, all the specimens that came under my notice, either in England or in this colony, being the more or less desiccated caterpillar, bearing on its head a spike a few inches long, covered near the apex with spore capsules.

A short time since, I visited a part of the bush near Tarawera, on the Napier-Taupo Road, and very carefully searched over a considerable portion of high, bush-covered ranges, near the township, for a rare and interesting plant which I had previously obtained in that locality; and in the course of my day's ramble, I collected the specimens which I have the honour to lay before you this evening.

Taking one of the largest of the specimens, we find that the length of the caterpillar is about $2\frac{3}{4}$ or 3 inches, and the smallest $1\frac{3}{4}$ - 2 inches.

The largest caterpillar supported a fungus about 12 inches in length, $2\frac{1}{2}$ inches of this being covered with densely packed spores. The number of specimens collected on this occasion was 16, 10 of which were mature, having the spore capsules fully developed, and six were immature. Three of the caterpillars were markedly smaller than the remainder, but, as far as could be seen, presented no specific differences. In all of the smaller specimens, however, the frontal shield, or scutellum (if any), was destroyed by the growth of the fungus.

Three of the caterpillars bore, what was then quite new to me, two or more spikes. The most remarkable of the three was a caterpillar $2\frac{1}{2}$ inches long, bearing a stout fungoid spike, which ascended for $1\frac{1}{2}$ inches, and then bifurcated, each branch being 9 inches in length, both being covered with spores for about 3 inches from the point. The second bore two spikes, each 6 inches long, both arising from the point of junction with the body, and both fertile. The third bore a many-branched spike, having nine points.

In the large majority of instances, the vegetable growth is seen to have arisen from the centre of the junction of the head and the scutellum, but in others, from either the right or left lobe of the head. In one case it occurs at the side of the first thoracic segment, and quite recently I have received from Major Scannell, of Taupo, a caterpillar bearing a spike at each end of the body; this being but the second time he has seen such a case occur, out of many hundreds of specimens.

The line of growth is, in all my specimens, coincident with the length of the body of the caterpillar, so that, if the caterpillar be placed in a crawling position, the "bulrush" extends in front of it like the bowsprit of a vessel. This is quite different to any of the engravings that I have seen in various books. Uusually the spike is represented as growing at right angles to the body, and the caterpillar is gaily crawling on the ground, bearing the spike, whilst what is presumed to be the perfect insect flies away in the distance. And now to return to my own specimens. All that I obtained I found buried in the ground in the dense bush, with but a very small proportion of what I have called "the spike" visible, and considerable care is required to dig out a specimen without breaking it, especially the finer ones.

In an article recently published in a Southern paper giving a lively account of this vegetable caterpillar, the statement is reiterated, which is found in all books on New Zealand, that the Aweto, or vegetable caterpillar, is only found under the rata tree (*Metrosideros*). Now, in the part of the bush from which my specimens came, there is no rata, and to find specimens it is best to look under the papa-namu (*Coprosma grandifolia*).

No trees can be more unlike than the *Metrosideros* and the *Coprosma*, and yet the larvæ probably feed on the leaves of either tree. It is possible that the differences perceptible in the caterpillars in the dried state might be more easily examined and determined when in the living and perfect state, but I have not yet had any opportunity of examining living specimens.

I believe vegetable caterpillars have been found in nearly all the forest districts of New Zealand. I have seen them from the Seventy-mile Bush (the Puketoi Ranges), Te Aute, Te Haroto, and Tarawera in this neighbourhood, and from various parts of the Wellington Provincial District.

And now let us examine a specimen a little more closely, and compare it with similar instances from other countries. On making a transverse section across the sporiferous portion, a closely-packed ring of conidia or spore-cases is seen arranged round a woody axis, the structure of which is not well-defined. The spore-cases, under the microscope, appear like grapes of a rich brown colour, and some appear to show a light spot near the outer end of the longer axis, through which probably the sporidia are discharged. Intermixed with the spore-cases occur numbers of what are probably linear sporidia, slightly twisted and jointed; sometimes these occur in tufts. In the "Handbook of the New Zealand Flora," the caterpillar-fungus is placed under *Cordiceps*, but in more recent works on fungology it appears as *Torrubia*, owing to the discovery by Tulasne of secondary forms of fruit.

Why this fungus should attack this particular species of caterpillar is at present a mystery. Kindred forms are found generally distributed over the world. Perhaps even more striking than our endemic species is *La Guêpe Végétale*, or vegetable wasp of the West Indies. In this case the wasp has been observed flying about with part of its body filled up with the mycelium of the partly-developed fungus (*F. sphæcocephala*).

In this case it is beyond doubt that the insect dies from the growth of the fungus, and that the fungus is not the subsequent intruder, as has been suggested in the case of our caterpillar. Another case in point, in which the fungoid growth certainly causes the death of the host, is the silkworm disease (muscardine). In all cases which have come under my notice the whole of the body of the caterpillar has been filled with the mycelium of the fungus, and nearly all traces of the internal structure obliterated.

It is well known that many of the larvæ of the larger moths hybernate for indefinite periods, and take a considerable time in coming to the pupa state. It may be that, during the dormant period of hybernation, the sporidia may work down the burrow of the insect and germinate, ultimately reducing the animal to the state in which we find it. It seems natural that a caterpillar when hybernating should remain with its head to the surface, ready to emerge when better times come round; and this would account for the general position of the fungus, quite as well as the theory that the spores become fixed in the interstices between the segments whilst the animal is entering the ground.

About twenty-five species of this genus of sphæriaceous fungi have been described in South Carolina; one in Pennsylvania, on a beetle, and one on a moth; one in Cayenne, two in Brazil (one on an ant), two in the West Indies, one in New Guinea, and one in Senegal. In Australia two species have been recorded. Dr. Hooker found two in India, in the Khassya Hills; three have been found in Great Britain, and one has been found in China, where it bears a great repute as a medicine, to be administered as stuffing to roast duck.

The genus *Cordiceps* (Fries), in the "Handbook of the New Zealand Flora," contains two species: *C. robertsii* (Berk.), and *C. sinclairii* ("Hbk. N.Z. Fl." p. 338). The second species is totally different in general appearance, and attacks the larvæ of one of the *Cicadæ*, or Singing Locust. Every year four or five of these vegetable-locust grubs are found in digging over a small patch of garden ground in the Petane Valley. I regret that I have not had time to examine these specimens closely, and consequently cannot offer any further remarks on them. I also regret that I am unable to lay before you the moth (*Hepialus virescens* ?) into which, if unmolested by the fungus, the caterpillar is said to develope. Any resident in the neighbourhood of any locality where vegetable caterpillars are found, might

add materially to our information on this subject if they could obtain for examination a number of living caterpillars. These might be obtained by spreading sheets under the tree in which they are supposed to occur, and then beating the foliage. We might then find out if any cases occur of the mycelium developing previous to hybernation.

ART. XLI.—*On the Metamorphosis of the Caddis Fly.*

By G. V. HUDSON.

[*Read before the Wellington Philosophical Society, 24th February,* 1886.]

Plate IX.

THE following paper is a short description of the metamorphosis of a species of Caddis Fly (*Phryganidæ*) which I have worked out during the past spring, and which, I believe, differs in several respects from any previously described. The imago is also interesting, as it bears such a close resemblance to a Lepidopterous insect; and, were its preparatory states unknown, it would very probably be catalogued as one of the *Tineina*.

Many entomologists are inclined to regard the *Phryganidæ* as a family of the *Lepidoptera*, and there is no doubt that a very close affinity exists between them; in fact one family of typical *Lepidoptera* (the *Hydrocampidæ*) are strictly aquatic in their habits, the larvæ constructing cases of duckweed, which they pull after them, holding on to the case inside by two hooks, exactly like the caddis worms; the pupa state is also passed floating on the surface of the water, and the moths are commonly taken flying over ponds during the summer.

The larva of this present insect (fig. 1) may be found commonly in the green, slimy weed floating in large masses on all stagnant waters. Being very small, it is rather difficult to detect, and is best procured by washing a small quantity of the weed in a saucer of water, when the little insects will be at once seen walking about at the bottom. On examination with the microscope, the case will first arrest attention, being of a most unique structure; its shape is best described as closely resembling that of a minute flask, very much flattened at the lower end, and almost transparent; its surface is slightly corrugated, and the neck of the flask constructed of a much denser material than the rest. It is open at both ends, the posterior end being perforated by a long, shallow slit, which extends for nearly the whole width of the case, thus admitting a free circulation of water round the larva, who is also able to turn round and project his head and anterior segments through the lower aperture, thus occupying the reverse position to that shown in the illustration. He is, however,

prevented from actually leaving the case by his abdomen, which is too large to be withdrawn from either end. The head and thorax of the larva are very strong in comparison with those portions permanently retained inside, the legs being constructed to fold up into the smallest possible compass, a cavity existing in each joint for the preceding one, this being a structure which is almost universal among the caddis worms. The two organs situated on the posterior segments are doubtless respiratory in their function, a large air-tube taking its rise from each, and ramifying through the body in all directions.

When alarmed, these insects retreat into their cases with lightning rapidity, remaining concealed until the danger is passed. Their food probably consists of the green weed, although they are perhaps carnivorous, feeding on the rotifers and other animalculæ, which swarm in the water where they are found.

With regard to the method employed by the young larva in constructing, and subsequently enlarging, his case, I can give no positive information, although it is undoubtedly made of a viscous fluid secreted by the insect, which hardens when exposed to the water; this secretion is no doubt analogous to the silk of caterpillars, which always exists in the form of a gummy fluid before being spun. In a few Lepidopterous larvæ (*Cerura*, etc.) it is employed as such to construct the cocoon, which is consequently of a much stronger consistence than where the ordinary silk is used. When about to change, the insect fixes his case down by four ligaments, two at each end, the extremities of these being firmly fastened on to a stone; he then closes the small aperture, and constructs a curious arch-shaped partition of dense material inside, a short distance from the broad end (fig. 2). In about a week's time he is transformed into a pupa, having the limbs, etc., free from the body, but incapable of motion. The fixing down of the case prior to the change may be easily performed by the larva from each of the apertures, which are no doubt left open till the last for this purpose. Before the final transformation the pupa breaks through the partition at the broad end of the case, and wriggles to the surface, the imago ascending a blade of grass to dry and expand its wings. The little exuvia of the pupa may be often noticed floating on the water, and the empty cases are very conspicuous on the sides of a glass aquarium, where the insects generally fix them down when in captivity.

This Caddis Fly (fig. 3) must be tolerably common during the summer, but owing to its small size would not be likely to attract attention. I have never observed it in a state of nature, all my specimens having been reared from the larva. It is probably undescribed; but as there are no catalogues of these insects at present published, it is impossible to speak with certainty on this point.

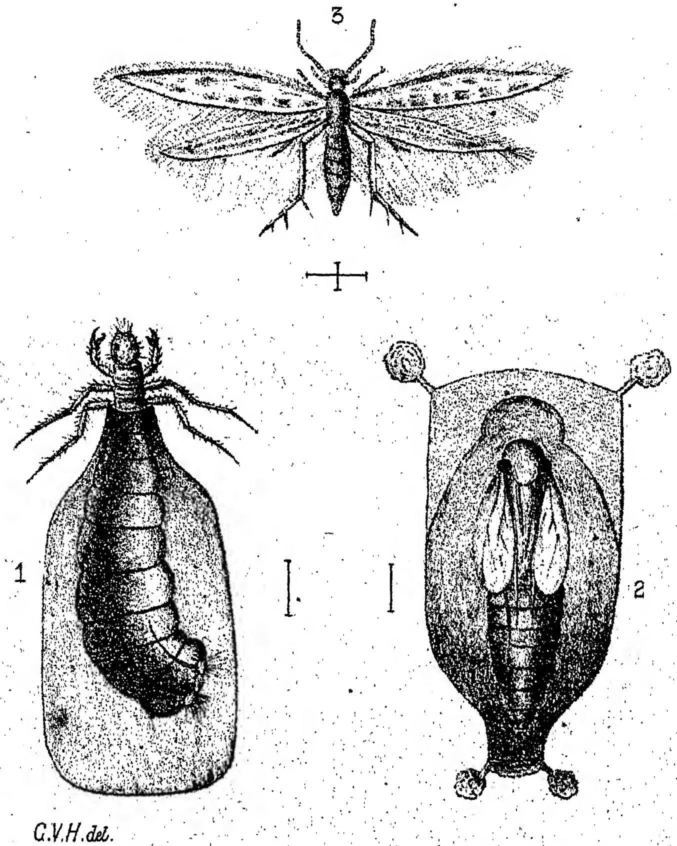


Fig 1. The larva in his case. Length when full grown 2 lines, of the case 3 lines.

Fig 2. The Pupa in his cocoon. Length 1⅔ lines.

Fig 3. The Perfect Insect. Length of body 1¼ lines. Expanse of wings 3 lines.

To illustrate Paper by G.V. Hudson.

Art. XLII.—*On some Specimens of* Vorticellæ *collected in the neighbourhood of Wellington.* By T. W. Kirk, Assistant, Geological Survey Department.

[*Read before the Wellington Philosophical Society (Microscopical Section), 15th February,* 1886.]

For some years past, whenever a *Vorticella* has come under my notice, I have made a sketch and taken careful notes. The receipt of a copy of Mr. W. Saville Kent's magnificent "Manual of Infusoria" has enabled me to identify most of the species observed. It should be remembered, however, that the present paper is only the result of a number of disconnected observations, and it must be distinctly understood that I do not for a moment claim to give an exhaustive list of the New Zealand *Vorticellæ;* on the contrary, I believe that there are probably double or treble the number of species here enumerated, and it is hoped that some microscopist, with sufficient time at his disposal to do the subject justice, may be induced to take up the search for and systematic examination of these flowers of the infusorian world.

Vorticella annularis, Müller.

(Saville Kent, Man. Inf., p. 689, pl. xxxix., figs. 28, 29.)

I am doubtful about the identification of this species. Specimens agreeing with Kent's description and figure, except that they were much smaller and the pedicel shorter, were obtained in a stream at Karori in 1880. They were attached to the stems of partially-decayed leaves.

V. marina, Greeff.

(Saville Kent, Man. Inf., p. 685, pl. xxxv., figs. 1-8; pl. xlix., fig. 30.)

Numerous examples are to be found at all seasons of the year in the small rock-ponds which abound on the shores of Port Nicholson and Cook Strait. The body is slightly more tapering posteriorly, and the pedicel is longer than in Kent's description, being fully seven times the length of the body.

V. oblonga, n. s.

Body oblong, nearly twice as long as broad, rounded nearly equally at both ends, encircled by a number of interrupted lines looking like puckers; pedicel stout, four times as long as the body, contracting by loops, and apparently too weak to support the body for long in an erect position, as it gradually leans either to one side or the other till it meets with some object, where it rests for a short time and then resumes the upright attitude. A large species, attached to seaweed.

V. longifilum, Saville Kent.

(Saville Kent, Man. Inf., p. 677, pl. xxiv., fig. 30; pl. xlix., fig. 10.)

Wellington Reservoir, September to February. Collected in 1884–5. Common.

V. campanula, Ehrenberg.

(Saville Kent, Man. Inf., p. 678, pl. xxxiv., fig. 36; pl. xlix., fig. 12.)

Wellington Reservoir, with the last-mentioned species, and equally common.

V. cratera, Sáville Kent.

(Saville Kent, Man. Inf., p. 679, pl. xxxiv., fig. 22; pl. xlix., fig. 14.)

Some specimens so closely resembling this species were obtained from water brought from the Wainuiomata, that I am compelled to refer them to it, although I was quite unable to detect any appearance of the "frill-like aspect presented by the peristome border," mentioned by Saville Kent. The border appeared to me to be perfectly whole.

V. citrina, Ehrenberg.

(Saville Kent, Man. Inf., p. 678, pl. xxxv., fig. 9; pl. 49, fig. 13.)

On *Azolla rubra*, from ditch in Evans Bay.

V. zealandica, n. s.

Body attenuate, from two to three times as long as the greatest breadth, tapering downwards, considerably constricted below the peristome, then swelling for rather more than half the length, when it again becomes constricted; then a nearly circular swelling, giving the posterior end an unusually blunt appearance. Apparently striated perpendicularly, but of this I am not certain, as sometimes the striations were seen, while at others they disappeared, as though at the will of the animal. Pedicel slight, four times the length of the body.

Pond in Newtown Park.

V. elongata, De Fromentel.

(Saville Kent, Man. Inf., p. 686, pl. xxxv., fig. 25; pl. xlix., fig. 42.)

Specimens were taken in November, 1884, from the pond in the Botanic Garden, attached to the leaves of the water lily. The pedicel, however, was much shorter than mentioned by Saville Kent, being never more than three times the total length of the body.

V. patellina, Müller.

(Saville Kent, Man. Inf., p. 679, pl. xxxiv., fig. 28; pl. xlix., fig. 16.)

Newtown Park and Wainuiomata.

V. nebulifera, Ehrenberg.

(Saville Kent, Man. Inf., p. 673, pl. xxxiv., fig. 20; pl. xlix., fig. 1.)

Ditch in Evans Bay, on *Azolla*; Botanic Garden pond, on grass.

V. striata, Dujardin.

(Saville Kent, Man. Inf., p. 684, pl. xxxiv., figs. 15-19; pl. xlix., fig. 29.)

On Algæ in Wellington Harbour, 1883, but not seen since.

V. aperta, De Fromentel.

(Saville Kent, Man. Inf., p. 680, pl. xlix., fig. 17.)

Examples closely resembling this species were obtained in 1884 from the pond in Newtown Park. The body, however, was fully twice as long as wide, and was more constricted beneath the peristome border than shown in Saville Kent's figure.

V. oblonga.

V. zealandica.

III.—BOTANY.

Art. XLIII.—*A Description of some newly-discovered Cryptogamic Plants, being a further Contribution towards the making known the Botany of New Zealand.* By W. Colenso, F.L.S.

[*Read before the Hawke's Bay Philosophical Institute, 14th September*, 1885.]

Introduction.

In my again coming before you with my usual annual tribute, a little basket of gleanings of simples, a small collection of plants gathered in the secluded shades and deep glens of the interior mountain forests, I would beg permission to preface my list of the same with a few remarks *ad rem.*

On this occasion, all that I have to bring belong to the third great botanical division—the class *Cryptogamia*, as it was named by Linnæus. Three of the Orders of this class will be found here represented, though not alike—viz., *Filices*, *Musci*, and *Hepaticæ*. Of the first, or Ferns, I have however only two novelties: one a tree fern of the genus *Hemitelia*, and one a species of *Botrychium*. For this latter we are again indebted to the kindness, mindfulness, and assiduity of one of our members, Mr. H. Hill. Specimens of these two ferns I shall exhibit.

Unfortunately, I shall not be able to show you specimens of the smaller cryptogams, these being all more or less microscopical, so that without a microscope, proper previous preparation of the objects, and patient attention, nothing worthy of notice could be seen.

Of the second Order, or Mosses, there are specimens of three genera—viz., of *Mnium*, of *Cyathophorum*, and of *Hookeria*; one each of the first two genera, and no less than twelve new species of the last-named, *Hookeria*.

Of the third Order mentioned, viz., *Hepaticæ*, or Liverworts, and of the first division, or foliaceous genera, there are 26 species belonging to six different genera; and of the second, or frondose division of that Order, there are also 17 species pertaining to seven genera, making in all a gross total of 59 new species of cryptogamous plants described in this paper.

Those several genera differ greatly, both in size and in their known homes; some of the genera are exceedingly small and rare; in a few instances, until now, only a single known species constituted the genus, as in *Cyathophorum* (a remarkably fine

moss, only found in New Zealand, the islets further south, and Tasmania); also, *Psiloclada* and *Zoopsis*, highly peculiar and beautiful delicate *Hepaticæ*, confined, like the former, to these southern lands. Other small genera, each containing a very few species, are *Fossombronia*, *Noteroclada*, and *Petalophyllum*; while other genera are very large, as *Hookeria*, a handsome and graceful moss, and *Jungermannia*, an elegant *Hepatica*; both of these genera being also found scattered all over the globe, including our native land.

One genus, however, of *Hepaticæ* I must particularly bring to your notice, and this is *Gottschea*, a fine, and pre-eminently beautiful, genus, and one almost exclusively our own; one which Sir J. D. Hooker, in his handbook, rightly calls "a noble genus;" of this charming genus I have had the good fortune to discover twelve additional species, (besides those recorded in the "Flora of New Zealand,") and I have little doubt that many more species will reward persevering and diligent botanists in the future; for, as Sir J. D. Hooker has further truly observed, "this genus is most abundant in New Zealand." Drawings of many of its species will be found correctly and beautifully executed by Sir J. D. Hooker in his "Flora Novæ-Zealandiæ; and, also, by his father, Sir W. J. Hooker, in his justly-distinguished "Musci Exotici," whose admirable copperplate engravings of drawings and dissections of those plants, and a large number of cognate ones from this country, must always evoke feelings of wonder and delight. Sir W. J. Hooker's drawings and descriptions of New Zealand cryptogams were published in 1818, and were made from specimens collected in New Zealand at Dusky Bay, nearly 100 years ago, by Dr. Menzies, who visited this country in 1791, in the ship of the celebrated navigator and discoverer, Vancouver, as the surgeon of the expedition. Dr. Menzies seems to have worked with a will in his pursuit of science, particularly in the acquiring of the smaller cryptogams, then not so very highly esteemed, of which he made a large collection both in New Zealand and at Cape Horn, and also in other countries visited by Vancouver in his voyage round the world. Several of our cryptogams, discovered by him, bear his name; conspicuously among them is that magnificent New Zealand moss, *Isothecium menziesii*, of which I can show you a fine drawing in the "Musci Exotici."

And here I may also briefly notice a very curious double coincidence, or combination of them, that happened at that very period. In 1791, when Dr. Menzies was engaged in the pursuit of science on the inhospitable shores of Dusky Bay, in this country, the celebrated French naturalist, La Billardiere, was similarly occupied on the then equally little known shores of Tasmania and New Holland. And, further still, specimens of

the same fine and peculiar species of cryptogams which were discovered by the one in New Zealand, were also discovered by the other in New Holland. La Billardiere's large 4to. work in two volumes, "Plantarum Novæ Hollandiæ," with nearly 300 drawings of new plants, was published early in 1804. Several of our plants also bear, and rightly so, his name. He was the naturalist attached to the expedition under D'Entrecasteaux, sent out by the French Government to discover the fate of, or obtain tidings of the famed, though unfortunate navigator, La Perouse.

I may also remark that these plants described by me in this paper are only a part, and a very small part, of the lesser cryptogams that I have collected during the past two years. A large number, amounting to several hundred specimens, exclusive of these herein described, have been separately put up for Kew, and will be forwarded thither by an early ship; not, however, that all of them are distinct species, for some are more than once repeated—even as I could, at more favourable and suitable times and seasons, find better specimens.

In mentioning this, a passing shade of mournful thought crosses my mind: namely, that that lot will be the *last*, in all probability, that I with my own hands shall ever collect. Age now, especially when in the dense woods, reminds me that my work of this nature is done. However, for more than half a century, this kind of work has been with me truly a labour of love; one in which the toils, trouble, and fatigue inseparable therefrom have been often forgotten, while enlarged and superior views of God and of nature have continually been attained.

New Zealand has long been noticed as the home of fine and beautiful ferns, but she is also the home *par excellence* of the smaller cryptogams, which, owing to her temperate climate, her many broken gullies—each containing a perennial streamlet—and her dense, shaded, and ever humid evergreen forests, flourish here in great perfection. It is my opinion that scarcely a tithe of those charming and wondrous productions of nature have yet been detected and made known. Rich harvests await her enthusiastic disciples in this direction. May great success and joy of heart ever attend all such.

I have already, in some of my earlier papers read here before you on former occasions, called the attention of the members of this Society to the pleasing, ever-evolving wonders of Nature, as seen in the close examination, the contemplation, and the study of her manifold productions, aided by the microscope. For while, on the one hand, it still remains true that no two leaves, no two blades of grass, are exactly alike in every particular; yet, on the other, the close and wondrous organization, the exact symmetry, and the perfection of all her works is clear and is astonishing. For whether we take, for instance, the tiny

leaf of a minute, slender *Hepatica*, or of a little wee moss, we shall find the truest adherence to the type in the form and the colour, the structure, and the regular shape of its cellules ; and so of the still more minute and more compound microscopical parts of their fructification,—as the external and internal teeth, etc., of the capsule of a moss. Here, in these very minute, and too often overlooked if not despised, productions of Nature, is to be clearly seen her trustiness, her regularity, her profusion, her glory, her beauty! Linnæus, contemplating them, truly exclaimed,—"Legi aliquot Dei vestigia per creata rerum, in quibus omnibus, *etiam minimis, ut fere nullis*, quæ vis! quanta sapientia! quam inextricabilis perfectio!"

Class III. Cryptogamia.

Order I. FILICES.

Genus 2a.* **Hemitelia**, Br.

1. *H.* (*Amphicosmia*) *stellulata*, sp. nov.

Trunk erect, 4–5 feet high, stout, girth at base 2 feet, under crown 1 foot 9 inches, dark brownish black below, covered with its own descending fibrous rootlets, that are soft, spongy, and light coloured at tips. Fronds, 26–30 in a crown, spreading, drooping, bipinnate, broadly lanceolate, not acuminate, 5 feet long, 2 feet 4 inches wide at middle, sub-coriaceous but softish, bright green, glabrescent, shining above, under-surface a little paler and finely stippled with white dots; pinnæ rather close set and overlapping, possessing (with segments) a rumpled semi-rugulose yet pleasing appearance, with numerous weak pale-brownish scattered reticulated scales on costæ and veins, especially on upper surface; stipe stout, very short, triquetrous, somewhat succulent and brittle, dark-brown, muricated (as also is lower rhachis), very scaly at base; scales 1¾ inches long, sub-ovate-acuminate with long filiform tips, dark-brown-red, shining, margined, margins erose (not serrulate), cells of centre numerous, narrow-linear, of margin larger and sub-quadrate; rhachis stout, sub-cylindrical, flattish above, pale-yellowish-green, sparsely warted throughout (also stipe) with small oblong and round coloured warts, running in a line between pinnæ; rhachis, secondary rhachises, and costæ densely covered above with reddish and yellowish strigillose hairs, and below with scattered long scarious reddish scales; under them is a peculiar short dark-red starry patent sessile pubescence, very closely set, which, with the long scales, though persistent, are easily rubbed off from exposed parts; pinnæ, middle, 14 inches long, 4 inches

* The numbers attached to the genera in this paper are those of them in "The Handbook N.Z. Flora;" but *Hemitelia* is not to be found separate in that work, being placed under *Cyathea*, No. 2.

wide, linear-acuminate, lower pairs distant and very short, 3–4 inches long; pinnules sub-linear-lanceolate, acute, 2 inches long, 8 lines wide, pinnatifid, regular, alternate, petiolate, petioles very short; segments alternate, 3 lines long, 1¼ lines broad, linear, falcate, the upper half coarsely serrate, acute, sessile, slightly recurved, the lowest pair free, petiolate, and crenate, sometimes only the single lowest one is petioled, this segment is always the shortest on the pinnule, divergent and largely crenate-serrate or lobed throughout; veins alternate, white, rather distant, 6-jugate, stout, lower broadly forked, upper simple, extending to margin, prominent below, sunk above. Sori not numerous, and confined to lower portions of segments and pinnules, rather large, obtusely conical, usually two on a segment on the lowest pair of veins just below the fork, and running in a single line on each side of costa of pinnule and close to it, sometimes (but rarely) 3–5 on a segment, especially the lowest pair; capsules numerous, minute, pyriform, shortly pedicellate, at first green, afterwards reddish, shining; spores trigonous; receptacle cylindrical, elongate, stalked, sub-clavate, puberulous; involucre a shallow membranaceous, whitish, and spreading cup, with even margin, marked with fine and closely-waved lines (*sub lens*), extending round costal half or little more of sorus, sometimes, but rarely, surrounding it at base, and, when so, always unequal, being much larger on the costal side, never, not even in the most incipient state, covering the sorus, which is always largely exposed.

Hab. Edges of forests, banks of streams in the Seventy-mile Bush, between Norsewood and Danneverke, County of Waipawa; 1882–5: *W.C.*

Obs. I. A species near to *H. smithii*, Hook. fil., (*Cyathea smithii*, "Flora N.Z.," and also "Handbook"), but widely distinct from that species in many characters (*vide* description, *supra*); although, without close examination and comparison, it is likely to be confounded with it, especially if only herbarium specimens are examined. I was for some years deceived through lack of close investigation, and therefore I have given more minutely its description.

Obs. II. This species (like a few other known ones) is intermediate between the two genera *Cyathea* and *Hemitelia*; and were its sori ever enwrapped in their involucres, it might well be placed under *Cyathea*, but such is not the case.

Genus 31. Botrychium, Linn.

1. *B. biforme,* sp. nov.

Rootstock thick; roots many, sub-tuberous, fascicled, straight, vertical, with long spreading horizontal rootlets, yellowish-brown. Plant glabrous. Stipe proper (or lower scape) about

1 inch long, with small ovate and entire membranaceous scales at base. *Sterile fronds* (generally 2): petiole 2–2½ inches long, medium thickness, not stout; lamina broadly deltoid, 3–4 (sometimes, but rarely, 5) inches diameter, triternate, very open and spreading; pinnæ distant on long narrow petioles, the central pinna usually the largest; dark brownish-green; texture sub-membranaceous, when dried wearing a rugulose sub-papillose appearance; veins very narrow, prominent, diverging; segments long, narrow, nearly linear, entire, 1-nerved; nerve very slender, extending to apices; tips acute and ofted bifid and spreading. *Fertile frond* (sometimes 2): peduncle 6–8 inches long, twice the height of the sterile frond, mostly very slender and flaccid, under 1 line in diameter, sub-erect and drooping, straight and flexuous, bright orange-coloured and glossy; panicle small, slender, sub-triangular in outline, 1–2 (rarely 2½) inches long, usually 1–1½ inches broad at base, (sometimes, but rarely, 3 inches broad, and when so the basal sub-peduncles are very long and naked below,) bipinnate, open, few and loosely branched; branchlets very short; light yellowish-green. Capsules small, globose, not crowded, sessile and sub-sessile, and (a few) pedicelled; dark-brown; valves oblong-orbicular, broadly gaping, recurved, margins thickened and reverted. Spores whitish, orbicular, slightly roughish.

Hab. In swamps, near Tahoraiti, County of Waipawa; April, 1885: *Mr. H. Hill.*

Obs. I. This species appears to me to be very distinct from all known ones. It usually bears two sterile and sometimes two fertile fronds. The outer or lower sterile frond arises from the base, is largely sheathing and connate; the upper one springs from the stipe about 1 inch above the lower one. When there are two fertile fronds, both are nearly basal from below the petiole of the upper barren frond, and are of equal length, similar to some species of *Anemia*. In one of my specimens the fertile stipe is single below, but divided a little above, each being of the usual size and length. There is a marked difference between the stipes of the barren and of the fertile fronds. These, of the latter, are of a light orange hue, and very glossy; those of the former are stouter, and of a dull brownish-green colour.

II. It is not, however, wholly to its bearing four fronds from one rootstock that I deem this plant to be a distinct species of *Botrychium*; but also from its linear entire segments, its rich, glossy, slender, flaccid and coloured scapes; its pedicelled capsules; its peculiar shaped valves; its circular spores, and its general outline and loose open appearance. Through the kindness of Mr. Hill, I have received upwards of 20 perfect plants, all good and fresh specimens, and they are very much alike, only one of them slightly differing, and that merely in size.

Order IV. MUSCI.

Genus 37. **Mnium**, Bruch and Schimp.

1. *M. novæ-zealandiæ*, sp. nov.

Plant rather large, gregarious, prostrate and creeping; fruiting stem erect, ¾-inch high, stout, densely shaggy, with brown rootlets, leaves rosulate at apex, with creeping barren leafy runners at base, 2–3 inches long, proliferous at apex. Leaves large, 3–4½ lines long, 1–2 lines broad, thin, pale (not yellowish) green, oblong and oblong-obovate, flat or very slightly undulate, very obtuse (sometimes retuse), apiculate, broadly margined, margins entire, slightly subsinuate, sometimes the apical portion is finely and distantly denticulate (but scarcely visible under a lens); nerve very stout, particularly at base, continuous but not excurrent; cells rather small, broadly oblong, alike throughout, obscure; leaves on the runners regularly pinnate, the upper half of each leaf free at the base from stem, alternate, with here and there a smaller leaf between on the under and also on the upper side of the branch. Fruit-stalk mostly single, sometimes two together, rather stout, smooth, erect, 1–1¼ inches high, slightly curved, reddish below, yellowish-green above, bulbous at base. Capsule oblong, 1 line long, cernuous; external teeth dark-brown, obtuse, each having four dark vertical lines, with their transverse bars in pairs and rather close; internal teeth pale, the transverse bars distant, and the ciliæ between (3–4) long, very slender, and finely knobbed at intervals; operculum the length of capsule, conical-subulate, obtuse, recurved. Calyptra very long, smooth, narrow, conical-subulate, 3 lines long; tip filiform, obtuse.

Hab. Low wet open spots in the interior, 1879–80, but always barren; wet shaded spots, sides of the River Mangatawhaiiti, Seventy-mile Bush, County of Waipawa, 1884: *W.C.* Glenross, County of Hawke's Bay, 1885: *Mr. D. P. Balfour.*

Obs. This species is near to *M. rostratum*, Schw., and also to *M. rhynchophorum*, Hook., but, after much close examination and comparison, I am satisfied it is specifically distinct. It differs from *M. rostratum* in its larger size, in wanting the excurrent nerve, and in the shape and size of its leaf and operculum, but more particularly in the teeth of its peristome, which differs very considerably from those of that species, as given by Schwaegrichen (Suppl. I., tab. 79); the external teeth of this species are of a very different colour, their transverse bars are closer and in pairs, each tooth also possessing four dark vertical lines; while the internal teeth are without perforations, with their bars more widely apart, and the intervening ciliæ more slender and knobbed at intervals; also, the vertical lines below the inner teeth do not run straight downwards, neither are the cells there regular, as shown by Schwaegrichen in his drawings,

but are of various angular shapes and sizes. This species also differs from *M. rhynchophorum*, Hook., in its operculum and in its leaves, which (in that species) are of a different shape, with their margin closely serrate throughout, and with large open cells at the base of the leaf. Sir. W. J. Hooker does not give any dissections in his plate, neither full particulars of this moss ("Journal Bot." vol. i.), so that I do not know the teeth, etc., of that species. I notice, however, that C. Müeller (Syn. Musc., vol. i., p. 158) has united those two species with others, but to me they seem very distinct.

Genus 68. **Cyathophorum**, Palisot.

1. *C. novæ-zealandiæ*, sp. nov.

Plant rather large, shortly creeping, sometimes tufted; stipe black, sub-rigid, very short, base and roots thickly covered with brown tomentum; stems sub-erect and decurved, (often pendulous,) flat, lanceolate, 2–5 inches long, ½ inch broad at middle, simple and branched above; branches patent, flexible, sub-opposite and pretty nearly together, and sometimes forked and proliferous. Leaves very thin, pellucid, glossy, bright emerald-green, distichous, sub-ovate-acute, cuspidate, 2½ lines long, sub-opposite, distinct, waved, and sometimes more or less slightly plaited, spreading, falcate, dimidiate, the upper basal portion overlapping the stem, the lower excised and not decurrent, the apical portion finely serrate on three-fourths of the upper margin, and on two-fourths of the lower; nerve 0, but in some leaves there is a very short and faint nerve; the leaves also possess a very short, stout petiole-like black nerve at their extreme base, uniting them to the stem, and from it a nerve-like plait runs into the lamina; cells, very narrow, linear and rectangular, arranged in transversely banded and wavy lines. Dorsal leaves broadly orbicular, strongly and distantly serrate above, very much cuspidate; cusp long, curved, aristate and capillary. The dorsal leaves on the branches, however, are sub-ovate-lanceolate, acute, and their lateral leaves are much smaller; perichætial leaves small, and of two forms: (1) the inner, broad, elliptic or sub-orbicular below, suddenly contracted above, the apical portion long, caudate-acuminate; tip sharply acute with 2–3 serratures some distance below the apex; (2) the outer narrow, acuminate, entire, both nerveless; cells long and narrow. Fruit-stalk erect, short, about 1–1½ lines long, largely bulbous at base, with a constriction between it and the vaginula; capsule oblong, turgid, about one line long, bright-green spotted with red, (sometimes wholly bright-red when mature,) sub-apophysate; and the outer teeth narrow, very acuminate, each with two vertical central lines; the inner teeth with a thick dark central vertical line; operculum small, one-fourth length of capsule, convex or flattish-hemispherical, broader than the contracted mouth of the

capsule, with a slender recurved beak; calyptra very small, $\frac{1}{40}$th inch long, only covering the upper part of the operculum, broadly conical, obtuse, roughish, brownish, the base irregular and slightly sub-crenulate.

Hab. In damp, shady woods, generally scattered among other mosses, etc., on rotten logs, both patent and pendulous; Seventy-mile Bush, County of Waipawa; 1879–1885: *W.C.*

Obs. I have long known this fine moss in its barren state, and, from my first detecting it, I supposed it to be specifically distinct from the only known species of this genus, *C. pennatum*, Brid. During the winter of 1885, I succeeded in obtaining fruiting specimens, which have fully confirmed my supposition. It differs from *C. pennatum* in several particulars: in size, form (often much and largely branched), and in its proliferous habit; when the tips are bowed down low among other mosses, etc., they often take root, and send forth new plants; in shape of leaves, particularly the dorsal and perichætial ones; in structure of capsule with peristome, in operculum, and in calyptra; as shown in both Sir W. J. Hooker's admirable drawings and dissections ("Musci Exotici," vol. ii., tab. 163), and also in those of La Billardiere ("Nov. Holl. Plant.," vol. ii., tab. 253), with their respective descriptions. Sir J. D. Hooker has also, in addition, noticed very briefly two varieties of *C. pennatum* —var. *a. minus*, and var. *β. apiculatum*; but as far as I can make out from his very short descriptions, this species is widely distinct from those two forms also; most certainly from the first, var. *minus*, which is a much smaller moss, with orbicular leaves, etc. (a drawing of it is given in his "Flora Antarctica," vol. i., tab. 62, fig. 3); this small variety was originally discovered by him at Lord Auckland's Islands in 1840; and, subsequently by myself, in New Zealand, on the banks of the upper Rangitikei River, in 1848. From the other variety, *apiculatum*, this species also differs, as that moss is said to have "shorter leaves" than the type, which are also "apiculate." Evidently, only barren or incomplete specimens of those two varieties mentioned by Sir J. D. Hooker were known to him.

This moss has caused me a large amount of extra labour, extending over several years, in revisiting so often those different localities in the high woods where I had detected and marked it, but always in vain until this year. It bears fruit in the autumn-winter, but not then plentifully; many places of its growth may be repeatedly visited, and very many plants examined, without detecting a single capsule.

Genus 71. **Hookeria**, Smith.

§ II. Mniadelphus.

a. Leaves with thickened margins.

* Leaves serrulate.

1. *H. smaragdina.*

** Leaves entire.

2. *H. concinna.*
3. *H. microclada.*
4. *H. amœna.*

β. Leaves without thickened margins.

* Leaves entire.

5. *H. subsinuata.*

** Leaves serrulate.

6. *H. pseudo-petiolata.*
7. *H. ramulosa.*
8. *H. subsimilis.*
9. *H. obtusata.*
10. *H. curviseta.*

§ IV. Eriopus.

11. *H. petrophila.*
12. *H. pygmæa.*

§ II. Mniadelphus.

1. *H. smaragdina*, sp. nov.

Plant small, erect, densely tufted and matted in large spreading patches, 6–8 lines high, much branched; colour a pleasing bright dark-green; stems and main branches reddish-brown; branches straight, linear, very narrow, $\frac{1}{20}$th inch wide. Leaves sub-quadrifariously disposed, very small, close, imbricate, spreading, not much altered when dry; lateral broadly elliptic, dorsal and ventral orbicular, apiculate, narrowly margined, the upper portion very finely and distantly denticulate, but scarcely perceivable under a lens; nerve 1, fine, cellular, extending beyond middle; cells orbicular and very small, but much larger and oblong about base; perichætial broadly ovate, very finely margined, entire, acute, cells large. Fruit-stalk erect, 4 lines long, usually springing from base of stems below leaves, red, shining, smooth, twisted, black at base. Capsule horizontal, narrow-oblong, somewhat sub-pyriform, sub-apophysate and slightly strumose, contracted below mouth; external teeth dark-brown, broad at base, very acuminate with two vertical central lines, closely transversely striate, margins dark ridged (or lined) and wearing a semi-denticulate appearance; internal teeth pale, slender, linear, with one vertical central line and a few distant transverse bars, no ciliæ. Calyptra small, conical, whitish, smooth, base largely fimbriate; fimbriæ spreading, recurved, obtuse; tip acute, black, with 4–10 pellucid, jointed, long white hairs largely produced beyond it, erect and straight,

Hab. On trees and logs, forming large patches; dark shady woods near Norsewood, County of Waipawa; 1885; *W.C.*

Obs. I. A species near to *H. rotundifolia*, Hook. fil. and Wils., but differing in several particulars: as, erect habit and being much branched, leaves broader and scarcely toothed, with smaller cells and longer nerve; perichætial entire; fruit-stalk longer, and springing from base of stem; capsule sub-apophysate and strumose, and calyptra with a peculiar long-haired tip.

II. The outer teeth of these species resemble those of *Hypnum tenuirostre*, Hook., and *Isothecium arbuscula*, Hook. fil. and Wils. It is an elegant little plant, though rarely detected in fruit.

2. *H. concinna*, sp. nov.

Plant procumbent in thick spreading tufts or small cushions, densely imbricate, much branched, soft, pale-green with a dash of yellow, and numerous very fine rootlets. Stems (and branches) brownish-red, 1–1½ inches long, rather stout, flattish, sub-deltoid, pinnately branched; branches numerous, close, irregular in length, ¼–½ inch long; branches linear, obtuse, patent, opposite (sometimes sub-opposite). Leaves very delicate, closely set, and somewhat sex-fariously disposed, broadly obovate-spathulate, about ½ line long, narrowly margined, entire; margin thickened below on narrow basal part of leaf; very obtuse, with a minute apical and mucro from margin only; nerve very fine, sub-sinuous, cellular, and extending two-thirds of leaf, shortly bifid a little below the top, the branch nerve very short; cells hexagonal-orbicular, very small at apex, much larger and oblong-hexagonal at base; perichætial oblong-ovate, sub-acute, cells larger, oblong. Seta slender, flexuous, 12–15 lines long, somewhat compressed, curved, twisted, smooth, glossy red. Capsule horizontal and cernuous (immature). Calyptra nearly 1 line long, enclosing capsule, narrow, glossy, black half-way from apex, largely fimbriate at base.

Hab. On upper branches of high trees, where it forms large and thick patches, and on the ground (but more rarely); dry forests near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species near to *H. adnata*, Hook. fil. and Wilson, differing, however, in its larger size and being much branched, in form of leaf and cells, in length and structure of nerve, in its much longer seta, etc. A very pleasing little species. It does not alter much in drying. Rarely detected in fruit.

3. *H. microclada*, sp. nov.

Plant small, sub-erect, 6–8 lines high, pale yellowish-green; stems stout, red-brown, except their tops, which are the same colour as the leaves; much pinnately branched from base; branches compressed with numerous fine red rootlets below. Leaves sub-sexfariously disposed and nearly alike, very close, imbricate, spreading, delicate, obovate-spathulate, entire, narrowly margined, slightly sub-sinuate, very shortly apiculate from

margin only; nerve single, slender, extending beyond middle; cells orbicular, very minute and partially obscure in the upper half, large oblong and clear in the lower; perichætial broadly ovate, entire, acuminulate; cells large and clear. Fruit-stalk 6–7 lines long, slender, smooth, flexuous, red, black at base, 3–5 on a branch; capsule very small, ob-conical, plain, sub-horizontal, brownish-red, broadest at mouth; outer teeth dark brown, closely transversely striate with sub-denticulate margins (as in *H. smaragdina*, Col., *supra*); calyptra long, conical, covering capsule, smooth, upper half black and glossy, apex much produced, sub-piliferous, base fimbriate; fimbriæ spreading, wavy.

Hab. On trees; dry forests near Norsewood, County of Waipawa, 1885: *W.C.*

Obs. A species pretty closely allied to *H. sinuosa*, Hook. fil. and Wils., but differing from that species, in its being much and pinnately branched, in its leaves being sexfariously disposed, delicate, with a very narrow and much less sinuate margin, and also apiculate; in the large cells of the lower half of leaf, and in the perichætial being acuminulate; also, in the shape of its small capsule, and its much shorter fruit-stalk, and in its smooth and glossy tipped calyptra. When dry its leaves are crisp; it moistens readily.

4. *H. amœna*, sp. nov.

Plant small, erect, ½ inch high, shortly branched at top, yellowish-green; and stems rather thick, dark brown, leaved to base, branches sub-compressed. Leaves numerous, close, imbricate, sexfariously disposed, very small, $\frac{1}{25}$th inch long, broadly spathulate, margined, entire, apical portion sub-orbicular, apiculate, margin very narrow, thickened on the basal portion of leaf; nerve 1, slender, sinuate, extending beyond middle; cells orbicular and very minute in the upper broad part of leaf, large oblong, quadrate in the lower portion; perichætial small, similar in shape, with long cellular acuminate scales within them; cells very large and clear. Fruit-stalk slender, 4 lines long, suddenly curved at apex, flexuous, twisted, smooth, shining, red, black and much thickened at base, springing from a tumid sheath or support (something like *Cyathophorum pennatum*) at middle of stem; capsule minute, $\frac{1}{30}$th inch long, narrow-ovate, pendulous, pale, finely and slightly tubercled at base; operculum not seen. Calyptra (young) narrow-conical, acute, greenish-white below, brown above and black tipped, the narrow upper portion slightly and finely roughish (under lens), largely fimbriate at base; fimbriæ spreading, obtuse.

Hab. Hidden among other mosses, etc. (whence it was picked out long after collecting); dry woods, near Norsewood, County of Waipawa, 1884: *W.C.*

Obs. This species is wholly unlike all others of this genus known to me. Having but a small tuft of a few stems, containing only one fruiting specimen, I did not break it up to examine its teeth, which appear to be very small and slender. It moistens readily.

5. *H. subsinuata*, sp. nov.

Small, tufted, erect, 6–8 lines high, simple (sometimes slightly short-branched at base), linear, broadest at top; stem short, stout, dark-brown, leaved from base; rootlets many, fine, red, at lower part of stem and base. Leaves small, numerous, close, imbricate, sexfariously disposed, all similar, ½ line long, obovate-spathulate, apex very obtuse and shortly apiculate, margin entire and slightly sinuous, light-green, finely nerved throughout ¾ths or more of leaf, apical portion of nerve sinuous; cells, upper half exceedingly small, orbicular, the basal portion very large and clear, sexagonal-oblong; perichætial small, oblong-acuminate, hyaline, nerve 0. Fruit-stalk erect, 3–5 lines long, slender, sub-flexuous, red, shining, black at base, 3–4 on a branch. Capsule (immature) narrow-oblong, gibbous above, nearly straight below, sub-apophysate, cernuous, shining, green with small red tubercles at base; operculum short, conical, obtuse; calyptra rather small, narrow, greenish-white, upper portion black, shining, tip acute, recurved; largely fimbriate at extreme base; fimbriæ spreading, sub-curly and waved (not straight), hyaline, linear, obtuse, containing dark-brown linear-oblong masses.

Hab. Among other mosses on rotten logs; low wet woods near Norsewood, County of Waipawa, 1885: *W.C.*

Obs. A species near to *H. flexuosa*, Mitten, but differing in several particulars.

6. *H. pseudo-petiolata*, sp. nov.

Plant small, tufted, erect, ¾ inch high, simple and 3-branched at top; stems stout, dark-brown below, green and highly cellular above, with red rootlets at base. Leaves pale green, oval, oblique, obtuse, 1½ lines long, somewhat distant, sub-decussate, serrate, lower margin near base excised and entire, lateral joined to stem by nerve only; nerve 1, very stout, cellular, extending half-way and forked about the middle, branch short; dorsal and ventral leaves similar but smaller, and broader at bases; cells large, sub-orbicular, equal throughout; perichætial very small, nerveless, entire, ovate, sub-acute and acuminate, tip obtuse with (sometimes) two serratures. Fruit-stalk springing from near base, erect, 10 lines high, wiry, rigid, shining, flexuous, dark-coloured, thickened at base, sometimes 2–3 on a branchlet. Capsule small, oblong, horizontal, spotted, finely reticulate, slightly tubercled at base; calyptra narrow conical, 1 line long, smooth, brownish, highly cellular; tip long, curved, acute; base slightly ragged.

Hab. On rotten logs, forests near Norsewood, County of Waipawa; 1884: *W.C.*

Obs. This little species presents a rather novel appearance from its leaves being scarcely broader at base than their stout nerve, and so giving them the appearance of being petioled. When dry, its stems and leaves are dusky green and blackish and completely curled up, but relaxing quickly on being moistened; their tips remaining recurved.

7. *H. ramulosa*, sp. nov.

Plant small, tufted, dendroid, stems 1½ inches high, erect, stout, dark-brown, covered with old leaves persistent below, branched at top 3–12 branches, each branch densely clothed with fine branched brown rootlets; branches narrow, 4–5 lines long, 1½ lines wide, simple and forked, flat, recurved, dark-green (almost black when dry). Leaves quadrifarious, sub-imbricate above, somewhat scattered and distant below; lateral obliquely oblong, broad, obtuse, spreading, small, less than 1 line long, somewhat irregular in size, the upper half of margins sharply and irregularly serrulate; nerve stoutish, shortly bifid, extending not quite to middle; dorsal and ventral elliptic-ovate, sub-acute, nerve short; cells rather small, orbicular, nearly alike throughout; perichætial broadly-ovate, sub-acuminate, very membranaceous, cells large oblong and clear, nerveless. Fruit-stalk erect, 4–7 lines high, smooth, rigid, red-brown, thickened and curved at base, springing somewhat laterally from upper side of branch near base, sometimes two together, and 5–6 on a single plant. Capsule narrow, about 1 line long, sub-horizontal, greenish, finely striate, with a few small and scattered, coloured, smooth tubercles at base. Operculum shorter than capsule, narrow, very obtuse. Calyptra as long as capsule, smooth, naked, cellular, and very much so, and slightly laciniate at base.

Hab. On logs among other mosses; wet shaded woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species near to *H. nigella*, Hook. fil. and Wils.

8. *H. subsimilis*, sp. nov.

Plant small, monœcious, tufted, sub-dendroid. Stem erect, ¼–¾ inch high, branched at top into 3–6 branches, sometimes single; colour dusky-greenish. Leaves sub-quadrifariously disposed, 1½ lines long, oblong, slightly obtuse and sub-acute, sharply serrulate, ¾ length from apex, nerved to beyond middle, and bifid near top; cells sub-orbicular, small, but much smaller at margins; dorsal and ventral broader and sub-acute; perichætial oblong-lanceolate, acuminate, entire, nerveless; cells large linear-oblong. Fruit-stalk 10 lines long, erect, slender, flexuous, twisted, slightly thickened at base, dark-brown, springing from upper side of stem, but near base, 2–3 on a branch.

Capsule oblong, spotted with dark-red spots, tubercled, pendulous; operculum long, half length of capsule, acute, and slightly recurved; calyptra long. conical, narrow, obtuse, smooth, laciniate at base.

Hab. In dark, low woods, near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species allied to the preceding (*H. ramulosa*), but shorter and less dendroidal, with fewer branches; leaves much larger, not so dark, and not blackish when dry, with a longer nerve, and minute marginal cells; fruit-stalk much longer and twisted; capsule thicker, tubercled, and pendulous; and calyptra lacerated at base. It is also a much scarcer plant; only a few fruiting specimens obtained. Leaves do not moisten readily.

9. *H. obtusata*, sp. nov.

Plant small, tufted, erect, $\frac{1}{2}$ – $\frac{3}{4}$ inch high, branched from near base, with 3–6 branches, branches recurved. Leaves very small, $\frac{1}{20}$th inch long, rather loosely disposed and sub-imbricate, broadly elliptic, very obtuse, serrate, the young ones and branches light green, very dark green when old, also when dry, fringed at margins below; nerve stout, short, bifid, cellular; cells large orbicular, alike throughout; dorsal and ventral leaves similar but smaller; perichætial broadly-ovate, suddenly contracted and acuminate at apex, entire, nerveless; cells large-oblong. Fruit-stalk erect, 5 lines long, bulbous at base, smooth, dark brown; 2–3 on a branch. Capsule, oblong, drooping; operculum nearly length of capsule, slightly recurved, acute; calyptra conical, smooth, acute, apiculate, entire at base or very slightly ragged.

Hab. In low, wet, shaded woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A peculiar and pleasing little species. Its leaves are often fringed at (or within) the margins on the under side with minute, jointed, cylindrical cellular bodies, in thick, powdery clusters, resembling the *soredia* of some lichens. Sometimes all the leaves on a branch are thus fringed, and, again, sometimes a branch is without any.

10. *H. curviseta*, sp. nov.

Plant small, erect, $\frac{1}{2}$ inch high, sub-dendroidal; stem short, $\frac{1}{4}$ inch, dark-brown, leafy, with numerous brownish-red rootlets at base; 4–5 short sub-rosulate branchlets at top, spreading, decurved. Leaves very thin and pale; lateral sub-oblong-obovate, obtuse, $1\frac{1}{4}$ lines long, upper half coarsely serrulate, the lower basal margin excised; nerve 1, stout, not extending to middle, bifid, the branch nerve very short; cells large, orbicular, pretty uniform throughout, but larger and oblong at base; dorsal and ventral leaves broadly-ovate-orbicular, very obtuse;

perichætial small, narrow-ovate, acute, entire, nerveless; cells large, clear. Fruit-stalk ½ inch long, erect, suddenly curved at top, smooth, red-brown, dark at base, 2–3 springing from axils of branchlets; capsule sub-obovate-oblong, nearly 1 line long, pendulous, pale reddish-brown, spotted with fine red dots, and finely tuberculated at the base usually in a kind of ring around it, minutely reticulated, margin of mouth dark; outer teeth rather short, obtuse, incurved, dark brown, with two broad vertical, light-brown equidistant lines, the centre partially clear, largely transversely striate, margins grossly sub-denticulate. Operculum and calyptra not seen.

Hab. Concealed among *Hepaticæ*, and from rotten logs; woods near Norsewood, County of Waipawa; 1884: *W.C.*

Obs. A species having some affinity with *H. obtusata* and *H. subsimilis* (mihi, *supra*), but differing from both in several particulars. Only two fruiting specimens have been detected, long after journey, among *Hepaticæ* collected.

§ IV. Eriopus.

11. *H. petrophila*, sp. nov.

Plant large, creeping at base, bushy, simple (rarely branched), diffuse; stems numerous, erect, 1½–2 (rarely 2½) inches high, 5–6 lines broad, flat, recurved at tips, of a pleasing bright-green inclining to dark, clothed with leaves from base, with many brown shining branched flattish rootlets below. Leaves sub-quadrifariously disposed, imbricate, thin, margined, margin narrow above, broader at base, upper half sharply serrulate, lower entire; cells large, sexagonal-orbicular, pretty uniform, but smaller and more orbicular at apex, and larger and oblong at base; lateral leaves oblong or sub-obovate, 2½ lines long, dimidiate, spreading, narrowed at base, tip suddenly acute, sharply apiculate, and curved on one side; nerve 1, very stout at base, straight, forked, largely divergent ⅓rd length of leaf; dorsal and ventral leaves smaller, much more orbicular, and more largely apiculate; nerves 2 from base, diverging; perichætial small, transparent, the outer broadly elliptic or sub-orbicular, the inner narrow ovate, all acuminate, the outer being very acuminulate or sub-piliferous, margins entire, serrulate at tips, nerveless; cells linear-rhomboidal, acute. Fruit-stalks 1–2–3 on upper part of stem and near each other, 3–5 lines long, succulent, green, thickened at base with a dark ring, annulated, hairy; hairs very short, thick and sub-tuberculous, patent, larger and longer at top, and these erect and forming a kind of small crest, but very distant from capsule and apex of seta, which are both glabrous, upper part of seta largely glabrous on the under side. Capsule oblong-elliptic, smooth, horizontal, with an elevated ring at mouth and contracted below, sub-apophysate, base slightly tubercled, dark-brown; teeth pale-red,

smooth, with numerous small orbicular cells, margins entire; operculum long, semi-conical, acute, beak very long, slender, straight. Calyptra large, broadly conical, obtuse, $\frac{1}{10}$th inch long, whitish, upper half thickly tubercled (or sub-echinate); tubercles irregular, long, blunt; laciniate and much fimbriate below; fimbriæ ragged, branched, spreading, obtuse, recurved. Monœcious; paraphyses numerous near bases of fruit-stalks; antheridia axillary near capsules, each linear sac clavate, containing a red globular spot near apex.

Hab. On stones in the bottoms of narrow deep watercourses; dark shaded woods near Norsewood, County of Waipawa; 1884–5: *W.C.*

Obs. I. A very fine species, certainly approaching very near to *H. cristata*, Arn.; but, after long and repeated examination, I cannot but deem it to be distinct. It also has some affinity with *H. lophophora*, Col. ("Trans. N.Z. Inst.," vol. xvii., p. 260). It differs, however, from *H. cristata* in size, habit, and form of stems and leaves, and in their colour, and in the form of its capsule, which is also sub-apophysate and tubercled (*vide* Hedwig, Sp. Musc., t. 49); in form and size of apex of leaf and apical cells (*vide* Schwg. Suppt., tab. ccxxviii., figs. A. B.); in its large and broad sub-tuberculous calyptra, laciniated at base; and in the short, thick, patent hairs on its seta and crest; and also in its peculiar *habitat* or place and manner of growth.

II. I have only met with this moss in deep, dark gullies, where it must be nearly always submerged; it clings strongly by its roots to pebbles in the soil, so that the support comes away with the plant in collecting; it bears fruit in June and July. Plants that I brought away living have flourished three to four months in a tumbler of water, in which they are mostly kept submerged.

12. *H. pygmæa*, sp. nov.

Small, tufted. Stems erect, 4–6 lines high, glossy dark-brown below, pale-green above. Leaves loosely imbricate above, distant below, light-green, crisped, and recurved when dry; lateral spreading, rotundato-ovate, largely apiculate, margined, serrate at top and for half-way down; lowest stem-leaves acuminate; nerve 0, or very short; cells rhomboidal, small at apex, increasing in size downwards, and large at base; perichætial long, narrow-ovate, entire, very much acuminate, the mucro subulate sharp, slightly serrulate at tip. Fruit-stalk 2 lines high, erect, flexuous, with a sudden bend at top, red-brown below, very hairy, with short patent hairs broad at bases or sub-muricated, hairs longer above with a crest of long white fimbriæ at top. Capsule small, ovoid, horizontal, apophysate; operculum flattish, with a long decurved acute beak; calyptra small, pale, largely laciniate and fimbriate at base; tip long, brown, shining, decurved.

Hab. Among other mosses on rotten logs; low, damp, dark woods near Norsewood, County of Waipawa, Nov., 1884: *W.C.*

Obs. An interesting little crested species, apparently near to *H. flexicollis*, Mitt. (of which S. Island species, however, I have not seen any specimens, and the description given of it in "Handbook N.Z. Flora" is scarcely complete). At present this species is very scarce, only one small tuft containing three fruiting specimens having been detected, after a most diligent and renewed search.

Order V. HEPATICÆ.

Genus 1. **Gymnomitrium**, Corda.

1. *G. orbiculata*, sp. nov.

Plant minute, erect, short, simple, sometimes with innovations, rarely branched, 6–8 lines high, pale-green, with fine long hyaline rootlets; leaves alternate, orbicular, entire, rather distant below, but sub-imbricate and larger at tips; perichætial large surrounding calyptra 5-lobed, lobes ovate-acuminate, obtuse; fruit-stalk 1½ lines long; capsule dark-brown; valves spreading, broadly lanceolate, much and irregularly reticulate, margins white and slightly sinuate; tips obtuse, naked.

Hab. Sides of perpendicular wet cliffs, River Mangatawhainui, near Norsewood, County of Waipawa; growing very closely intermixed among *Aneura muscoides*, Col.;* October, 1884: *W.C.*

Obs. This species in size and appearance is not unlike the only other known New Zealand species, *G. concinnatum*, Cord., detected by me on the summits of the Ruahine mountain range, its only known New Zealand habitat (but also found in Britain); it is, however, widely different as a species. Its only known habitat is a curious one; closely bound up (or squeezed tightly) among *Aneura muscoides* (*infra*), and only to be detected (when not in fruit) by the extreme tips of its leaves just peering above those of the *Aneura*.

Genus 2. **Jungermannia**, Linn.

1. *J. humilissima*, sp. nov.

Minute, shortly tufted, erect, 3–4 lines high, pale-green, with fine long rootlets below and at base. Leaves laxly imbricate, sometimes more distant, sub-vertical, amplexicaul, slightly decurrent, sub-orbicular, quite entire, apical margins very slightly sinuate, recurved; involucral similar but larger, conniving; cells minutely beaded; apical small, orbicular, basal larger, oblong. Stipules 0; perianth 5-plicate, mouth contracted, toothed. Fruit-stalk 5 lines long, slender, capsule globose, very small, dark purple, glossy.

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* See p. 251 *infra*.

Hab. Closely mixed with other small *Hepaticæ* and minute mosses, wet stony sides of the River Mangatawhaiiti, County of Waipawa; 1885: *W.C.*

Obs. A species having affinity with *J. inundata*, Hook. fil., also found in this district.

2. *J. rufiflora*, sp. nov.

Small, densely and regularly tufted in large spreading patches, erect, 3–6 lines high, pale-green, simple and branched below, connected at base, stems succulent, flexuous. Leaves few, vertical, alternate, distant, sometimes laxly imbricate, especially on old stems; smaller orbicular and pink-margined below, gradually increasing in size, elliptic and sub-apiculate above; semi-amplexicaul, quite entire, very membranous and translucent, somewhat recurved; involucral 1–2, very similar, but larger; cells large, sub-orbicular, nearly alike throughout, the upper minutely and many beaded. Perianth large (for the plant), about 1 line long, obovate-spathulate, 4–5 plicate, mouth large, laciniate, tips pink-red. Stipules none. Fruit-stalk 3 lines long, slender; capsule globose, dark brown; valves broadly oblong-lanceolate, reticulate, slightly margined; tips very obtuse.

Hab. Steep shaded and wet cuttings, clayey sides of main road near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species having pretty close affinity with the preceding species (*J. humilissima*, mihi). It is a striking and neat object in its flowering season, owing to the tips of its numerous and compact perianths being coloured a lively pink-red, and generally each stem bearing one, and all of a uniform height, so that it is detected at some distance when passing by.

3. *J. paucifolia*, sp. nov.

Plant small, tufted, densely compact; stems erect, 4–6 lines high, regular, simple, rarely branched at base, light green, with many fine pellucid rootlets springing from bases of leaves. Leaves few, rather distant, alternate, vertical, $\frac{1}{20}$th inch long, broadly sub-orbicular, somewhat truncate at tip, recurved, undulate and sub-plaited, narrowly margined; margins entire, those of upper leaves sub-sinuate; sub-canaliculate, not decurrent on stem, largest above and very small at base; cells large, oblong, each 5–7 beaded; involucral similar, but larger. Stipules 0. Perianth broadly obovate, slightly compressed, with sinuous edges, apex very truncate, 5–6 plaited at top, mouth contracted, tips curved, acuminate, each with a minute pencil of 3–4 fimbriæ. Seta 2 lines long, slender, twisted, transversely veined. Capsule very minute, globular, dark brown, bursting rather irregularly; valves narrowly margined, obtuse, and much reticulated with black lines.

Hab. In large patches with the preceding species (*J. rufiflora*); patches generally distinct, but sometimes intermixed; 1885: *W.C.*

Obs. This species is nearly allied to the two preceding ones, but distinct. It also flowers much later in the season.

Genus 7. **Gottschea,** Nees.

* Leaves stipulate.

1. *G. læte-virens*, sp. nov.

Plant gregarious, procumbent, imbricate, simple, 1 inch long, 4 lines wide, flattish, sub-linear-obovate, sometimes shortly 2–3 branched near top. Leaves lively emerald-green, very thin, ovate, obtuse, spreading, serrulate at tips, ciliate on upper margins near stem, distant and free below, imbricate and crowded above; ventral lobes more largely serrate at tips; the dorsal of a similar shape but smaller, their upper edge nearly entire, lower edge adnate on ventral lobe; involucral laciniate. Stipules rather large, 4–5-fid, much laciniate and spreading; cells oblong-orbicular, walls thickened; fine purple rootlets on lower part of stem.

Hab. In patches on rotten logs, woods near Norsewood; and more largely on the ground in dark shaded low woods, sides of River Mangatawhaiiti, between Norsewood and Danneverke, County of Waipawa, 1884–5: *W.C.*

2. *G. nitida*, sp. nov.

Plant gregarious, procumbent, imbricate, green, stems stout, 2 inches long, ½ inch wide at broadest part, simple, and 2–3–4 branched; branches patent, irregular, flattish, sub-linear-obovate. Leaves sub-oblong-lanceolate, sub-acute, patent, sharply and closely serrulate, largely ciliate on both margins near bases, but most so on the upper, also at tips, distant and free below, much crowded above; the dorsal lobes oblong, truncate at tip, the upper edge and apex largely ciliate-serrate; ciliæ jointed; lower edge adnate on ventral lobe. Stipules large, laciniate to base, 5–6 lobed, very ciliate; ciliæ long, jointed, drooping, glossy; perichætial pale-green, long, narrow, and much laciniate; cells orbicular, and larger than in *G. læte-virens;* many red rootlets at base and on lower half of stem.

Hab. In patches on the trunks of large trees; dark shaded woods, near Norsewood, County of Waipawa, 1885: *W.C.*

Obs. A fine species, having affinity with the preceding (*G. læte-virens*), which it closely resembles at first sight, but is very different in structure, more compound and larger.

3. *G. macroamphigastra*, sp. nov.

Plant in small patches, sub-prostrate, ascending, pleasing green, stems thick, succulent, oblong, 10–15 lines long, 4 lines wide at broadest part near top, shortly branched, rooted below; root-stock stout; rootlets numerous, short, red, and matted. Leaves spreading, lobes concave; ventral oblong, acute, falcate,

serrate above, laciniate below; dorsal shorter, tips sub-truncate and serrulate, rotund and overlapping at base, and much broader than the ventral lobe, margin there entire, or under a high power minutely serrulate in the anterior portion, the apical serrulate on both margins with a narrow plait extending from lower point of apical margin to outer margin of ventral lobe; involucral narrow, 2 lines long, much and compound laciniate, connate at base; cells orbicular. Stipule very large, sub-quadrate, 1½ lines wide, sub-bilobed at tip, much laciniate; laciniæ largely cellular throughout.

Hab. On rotten logs, among other *Hepaticæ* and mosses, Seventy-mile Bush, County of Waipawa; 1883: *W.C.*

Obs. A very distinct species, from its large and broad stipules, and the concave lobes of its leaves; hitherto, however, it is rather scarce.

4. *G. heterocolpos*, sp. nov.

Plant small, procumbent, spreading, pale green, stems stoutish, leaved to base, 1–1½ inches long, 3–4 lines broad, much (5–6) branched, branches short, flattish; rootlets purple, very numerous, short and matted below. Leaves sub-ovate, falcate, acute, finely and sharply serrate; ventral suberulent or minutely and closely roughish at tips on both sides, laciniate-ciliate on lower basal margins; dorsal similar in shape, but much smaller and smooth, obtuse and sub-truncate at tips, with finer and more distant serratures, and a ridge or plait running from the lower angle of apex to outer margin of the ventral lobe, basal margin almost entire; cells sub-orbicular, cell-walls thick. Stipule rather large, sub-quadrate-cuneate, narrowest at base, bifid, lobes divergent, each lobe sparingly and coarsely laciniate above, not below, sinus large orbicular. On the stem on each side, within the two lobes, and in their axils, are several small narrow scale-like laciniated processes or leaflets, and also in minute tufts near to the bases of the stipules, but separate and above them.

Hab. In forest, Seventy-mile Bush, County of Waipawa; 1882: *W.C.*

Obs. The exact locality of this peculiar species is at present unknown; the few specimens I have were brought hurriedly away, and merely for comparison, believing them to be identical with other species lately detected there by me. I may, however, find it again.* It is a highly curious species, in its possessing those minute, scale-like leaflets in the axillæ of its leaf-lobes; in this character, however, it is something like *G. nobilis*, Nees, the only other species known to possess it. [But see the following species, recently discovered.]

* Since writing the above, I have again found this plant; June, 1885: its exact locality is in wet low woods, near Norsewood.

5. *G. trichotoma*, sp. nov.

Plant procumbent, spreading, 2–3 inches long, much branched, main branches generally trichotomous at tips; stems leafy, stout, with many brown rootlets at bases, branches about 1 inch long, 4 lines wide, linear, obtuse, slightly rooting at bases; rootlets brown. Leaves a pleasing green, spreading, rather distant below, base of stem bare, close above, oblong-ovate, obtuse, sharply and closely serrate, laciniate-ciliate on basal margins, a ridge or plait running from lower anterior angle of dorsal lobe to the margin of the ventral, with a few other small, scattered, short creases or low plaits on its lamina; dorsal similar in shape and smaller, apices free, bases broadly rounded. Stipule large, quadrifid, segments much laciniate-ciliate: ciliæ long, flexuous, pellucid, jointed (as in *G. chlorophylla*). On the stem, between dorsal and ventral lobes, are two transverse lateral rows of finely laciniated processes or leaflets.

Hab. Among other *Hepaticæ* and mosses on prostrate trees, wet forests near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A fine species, having close affinity with the preceding, *G. heterocolpos*, in its additional stem-leaflets (which, however, are longer, narrower, more numerous, and differently situated), but widely differing in its compound ciliated stipules, etc.

6. *G. chlorophylla*, sp. nov.

Plant very small, under ½ inch long, obovate-oblong, broadest at tip, very obtuse, simple, and 2–4 branched from near base. Leaves closely imbricated, pale green, whitish tipped, oblong, obtuse, margins irregular and sub-laciniate, much ciliated, each lacinia ending in a long cilia; ciliæ all jointed; dorsal lobe similar, but much smaller; cells orbicular. Stipules broadly cuneate, or sub-quadrate-flabelliform, laciniate-lobed, each lobe ending in two large ciliæ: sinus broad.

Hab. On rotten logs, watercourse; deep forest near Norsewood, County of Waipawa; 1883–85: *W.C.*

Obs. A species near to *G. ciliata*, Mitt., but differing in its laciniated stipules and leaves, smaller dorsal lobes, and much smaller size. It has a very hoary appearance on both sides, from its pale colour and long ciliæ. It is apparently scarce, having only very sparingly been met with.

7. *G. bicolor*, sp. nov.

Plant densely gregarious in large patches, simple, broadly obovate, 4–6 lines long, 2 lines broad at tips. Leaves light-green below, bright yellow-green above, sub-imbricate, spreading, sub-falcate, finely laciniate-serrate, especially at tips; dorsal lobes upper margins entire, rounded and broad at base, and overlapping on stem; tips truncate and minutely serrulate; cells sub-quadrate and oblong. Stipules sub-quadrate, bi-lobed

to base, sinus sub-orbicular, lobes laciniate, divergent at base connivent above.

Hab. On rotten logs, dense wet forests near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A small species, having some affinity with *G. lætevirens*, mihi (*supra*), but differing in its leaves and stipules, also in size and colour.

8. *G. pallescens*, sp. nov.

Plant small, scattered, prostrate, simple, and shortly two-branched, broadly obovate, 3–5 lines long, 3 lines broad and much rounded at top, flattish, stems rather stout, with many pink rootlets below, at and near base. Leaves very pale or yellowish-white, close, compact, spreading, sub-ovate-oblong, acute, sub-laciniate-serrate throughout, overlapping at base; dorsal lobes similar, but much smaller, tips somewhat truncate and serrulate; cells orbicular, cell-walls very thick. Stipules very large, sub-quadrate, but broadest at top, bi-lobed (almost quadrifid); sinus open, lobes much laciniate and largely divergent above.

Hab. On rotten logs, among other small *Hepaticæ*; wet shaded woods, Seventy-mile Bush, County of Waipawa; 1883: *W.C.*

Obs. A species near to *G. bicolor*, mihi (*supra*), but differing from it in its larger spreading stipules, and in being much more laciniate, also in colour, form, and habit.

9. *G. marginata*, sp. nov.

Plant prostrate, creeping, simple, sometimes branched below 1–1½ inches long, 4 lines wide, broadest at top, green; stem stout, succulent, with many brown rootlets at base. Leaves close above, distant below, sub-oblong-ovate, rather obtuse, subfalcate, spreading, laminæ with several small plaits or creases, largely serrate at apex, coarsely laciniate at base; dorsal lobe very broad, rounded, and overlapping below, with the margin entire, or nearly so, truncate and serrate at tip; cells oblong, large, stipules rather large, sub-obovate-quadrate, bifid to middle, each segment once lobed on the outside and laciniate; laciniæ few and rather distant, triangular, acute, not capillary nor ciliate, and all many-celled throughout; cells large; main sinuses orbicular, with their margins thickened as if doubled or bordered. Capsule (immature) cylindrical, narrow-linear, 3 lines long, dark-purple; fruit-stalk sub-clavate at top, but contracted at junction with capsule.

Hab. On trunks of fern-trees, wet shaded forests near Norsewood, County of Waipawa, 1885: *W.C.*

Obs. A species having close affinity with *G. pallescens*, mihi (*supra*).

10. *G. albistipula*, sp. nov.

Plant small, bright light-green; stems sub-erect, simple, 1–1¼ inches long, obovate-oblong, truncate at tip, 4 lines wide in the broadest part, leaved to base; stem stout, succulent, white, with fine filiform rich purple rootlets at base. Leaves thin, closely imbricate, spreading, falcate, ovate-oblong, obtuse (sometimes with a tooth as a mucro), each with 3–4 narrow plaits or creases extending diagonally to margin, the margins of the upper half coarsely serrulate, the lower half of basal margin nearly entire, the upper half of the same laciniate; laciniæ increasing in size towards the stem, and there shortly decurrent; dorsal lobe much broader at base than the ventral, and largely rounded and overlapping the stem, the margin very slightly serrulate and decurved, the apical portion truncate; cells sub-orbicular, rather small. Stipules white, rather large, sub-quadrate, narrowest at base, bi-lobed to middle, sinus large, with two minute laciniæ; lobes broad at top, coarsely laciniate, not ciliate; laciniæ obtuse, celled to apices; cells of various shapes and sizes, mostly orbicular-oblong, large, clear, and double-walled. Fruit-stalk 15 lines long, stout. Capsule narrow, linear-oblong, purple; valves spreading, 2 lines long, linear-lanceolate, very obtuse, not meeting at base, but with a small hemispherical pilose boss in the centre, finely and closely striate longitudinally and transversely with minute dark-brown striæ. Spores orbicular, numerous; no spiral elaters detected.

Hab. On rotten logs and on the earth, forming compact patches in shaded spots; wet woods, near Norsewood, County of Waipawa, 1885: *W.C.*

Obs. A species nearly allied to *G. macroamphigastra*, mihi (*supra*), but differing in its being unbranched, with much less concave leaves, that are also largely plaited, and in its very much smaller and differently-formed white stipules.

** Stipules 0.

11. *G. simplex*, sp. nov.

Plant small, sub-gregarious, simple and sparingly branched, under 1 inch long, 3 lines broad, sub-obovate-linear, very light-green, of a soft texture. Leaves below distant, narrow-oblong, obtuse, and nearly quite entire; the upper not crowded, linear-ovate, slightly and finely serrulate, more so at tips; dorsal small, scarcely half as long as the ventral, sub-elongate-quadrate, upper edge slightly curved, truncate at apices, margins entire; cells small, sub-orbicular; rootlets numerous, long, purple; stipules 0.

Hab. On the ground, among other *Hepaticæ* and mosses; banks of the River Mangatawhaiiti, between Norsewood and Danneverke, County of Waipawa; 1885: *W.C.*

Obs. A curious little naked species, without stipules, and with margins nearly entire, and therefore having affinity with *G. tuloides*, Hook. fil. and Taylor, another New Zealand species formerly discovered by myself; also pretty near to two preceding species (in this paper), *G. læte-virens* and *G. nitida*, from the same forests.

12. *G. ramulosa*, sp. nov.

Plant creeping, prostrate, ascending, stem 1–1½ inches long, 4 lines broad, linear, obtuse, flattish, thickly rooting below on lower part of stem, much branched with several short branchlets at tops. Leaves numerous, and very closely set from base, somewhat inflated, spreading, stem-clasping, pale-green; ventral ovate-oblong, acute and finely serrulate at tips; upper margin rounded, lower nearly straight, both margins entire and slightly recurved; dorsal lobes similar, but much smaller, sharply acuminate at upper angle of tip; cells orbicular, small; stipules 0. Involucral long narrow acuminate and much laciniate-serrate. Fruit-stalk short, shorter than involucral leaves; capsule broadly ovate, red-brown.

Hab. On bark of trees, among other *Hepaticæ* and mosses, spreading in small patches, but apparently very local and scarce; forest between Norsewood and Danneverke, County of Waipawa; 1883: *W.C.*

Obs. A species having some affinity with *G. tuloides*, Hook. fil. and Taylor, and with *G. simplex*, mihi (*supra*), from its not possessing stipules, and its nearly entire leaves.

Genus 9. **Psiloclada,** Mitten.

1. *P. digitata,* sp. nov.

Plant minute, procumbent, very membranaceous. Stems 1–2 inches long, very slender, pinnately branched, with fine rootlets at tips. Leaves pale-green, microscopical, rather close set, sub-quadrate in outline, patent, those on main branches much broader than their stems, 3–4 lobed, the blade as long as or longer than the lobes, and appearing as if 5–7 nerved; lobes subulate, spreading, with the apparent "nerves" continued into them; cells large, regular, oblong or sub-quadrate, extending to tips of lobes. Stipules similar, but much smaller and adpressed. Fruit, etc., not seen.

Hab. Damp shady woods, among other *Hepaticæ* and mosses, near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. The cells of this little plant somewhat resemble those of *Lepidozia patentissima*, only they are more regularly disposed in lines among the apparent "nerves." Some of the long capillary branchlets have also the appearance of fine rootlets at their tips, as in some *Lepidozia*. The 4-lobed leaves, with their

dark and straight lines of "nerves," bear a close resemblance to the back of a gloved hand. It is a beautiful little plant, having a strong resemblance in habit, form, and texture to the only other (known) species, *P. clandestina*, Mitt.; but, from the absence of fruit, it is somewhat doubtful as to genus. At present the plant is scarce, only two specimens having been detected; from its minuteness, however, it is easily overlooked.

Genus 13. **Lepidozia,** Nees.

1. *L. concinna*, sp. nov.

Plant largely and loosely tufted, branched, procumbent, overlapping, pale-green, 2–3-pinnate; branches 1–2 inches long, 4–5 lines wide, sub-oblong-lanceolate; branchlets 2–2½ lines long, widely apart, alternate, decurved, the shorter ones broad and rounded, and the longer ones capillary at tips. Leaves many, closely set and sub-imbricate on branchlets, more distant on main stems, patent, slightly incurved, sub-quadrate, 3–4-fid; cells strongly defined and numerous, large in the centre at base of leaf. Stipules small, quadrate, 4-cleft to middle, patent; segments subulate, acute, spreading, sinus wide, round at base; cells of segments in 3–4 rows, very minute, distinct, regular.

Hab. On living trees, forming thick and large patches; wet forests near Norsewood, County of Waipawa, 1885: *W.C.*

Obs. An elegant species, allied to two of the known New Zealand ones, *L. microphylla*, and *L. pendulina*, Lind.; also to the following one, *L. cancellata*, mihi; and also to *L. chordulifera*, Tayl., a species of the Chonos Archipelago. The leaves in shape and in cell-areolæ are somewhat like those of *L. procera*, Mitt., a Tasmanian species, but the plant is widely different.

2. *L. cancellata*, sp. nov.

Plant largely and loosely tufted, of a pleasing green; branches 1½ inches long, 3 lines broad, linear-lanceolate, rarely branched at base, sub-procumbent, loosely overlapping, bi-pinnate; branchlets numerous, alternate, rather closely set, short, 1–1½ lines long, very rarely again branched, tips sometimes capillary, and then exceedingly fine and reddish. Leaves large, sub-oblong-quadrate, 4-fid, cancellate, very close, incurved (presenting a sub-verticillate appearance), those on the main stem more distant and very large; cells large; segments very long, curved and spreading, subulate, acute, each with a single row of cells; sinus large, round. Stipules similar but smaller, distant, patent.

Hab. On trees and logs, forming large and thick patches; forests near Norsewood, County of Waipawa, 1885: *W.C.*

Obs. A species very near the preceding (*L. concinna*, mihi), but differing in its more slender and simple branches; in its

shorter and closer branchlets that are rarely capillary, and when so, finer than fine hair and coloured; in its larger leaves with larger open cells visible to the naked eye, and in their much longer segments which are also in single-celled rows throughout. A truly elegant plant.

3. *L. subverticillata*, sp. nov.

Plant small filiform procumbent spreading, closely adhering to rotten wood, much and irregularly branched; light-green. Main branches 2 inches long and more, sub-bi-pinnate, narrow, linear-oblong; branchlets short, alternate, tips occasionally but seldom capillary. Leaves highly cellular, close set, overlapping (having a sub-verticillate appearance), sub-oblong-quadrate, 3- (sometimes 4-) fid; lamina very short, scarcely any; segments very long, articulate, incurved. Stipules similar, but smaller and more distant. Perianth terminal on short lateral branchlets (sometimes two close together), very large for the plant, cylindrical, 2 lines long, vertical, largely ciliate at tips with 6–9 long flexuous ciliæ; cells large, narrow-oblong; involucral leaves large, cellular, sub-broadly-ovate, tips slightly laciniate.

Hab. On rotten logs, forming small thick patches; in wet forests near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A very neat little species of a pleasing green colour; its affinities are with *L. capillaris*, Lind.

4. *L. minuta*, sp. nov.

Plant minute, prostrate and creeping, wiry, irregularly branched, pale-green, with long white capillary pellucid radicles below. Main branches about 1 inch long, with many capillary branchlets $\frac{1}{2}-\frac{3}{4}$ inch long. Leaves rather small, close set, and sub-imbricate, patent, quadrate, 4-dentate, larger and more distant on the main branches; lamina large; teeth short, broadly-triangular, acute, incurved; cells small, sub-orbicular, distinct, much larger in the centre of leaf. Stipules minute, distant, similar to leaves but much smaller, 3–4-toothed. Perianth lateral, sub-sessile on main stems; involucral leaves rather large, oblong-ovate, slightly laciniate; cells large.

Hab. Among mosses and small *Hepaticæ,* on decaying logs; wet woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species having close affinity with *L. lævifolia*, Lind.

Genus 14. **Mastigobryum**, Nees.

1. *M. concinnatum*, sp. nov.

Plant a pleasing light-green, densely and regularly tufted, shortly creeping, imbricate; stems $\frac{3}{4}-1\frac{1}{2}$ inches long, dichotomous; branches $\frac{1}{2}$ inch long, linear, $1\frac{1}{2}$ lines wide, obtuse, divergent, sending down long scaly and hairy rootlets; young branches and rootlets highly cellular. Leaves close, distichous,

spreading, imbricate at base, flat, falcate, sub-ovate-oblong, truncate, 3-toothed; teeth acute; dorsal margin curved, ventral straight; cells orbicular, small and distinct at apex, larger and very compact at base; young leaves with compact sub-quadrate cells. Stipules rather large, free, sub-quadrate, usually 6- (sometimes 4- and 8-) toothed; teeth small, blunt; cells smaller than in leaves and more distinct (very much like those of *M. novæ-zealandiæ*, Mitt.). Fruit not seen.

Hab. Forests near Norsewood, closely overlying mosses (particularly tufts of *Leucobryum candidum*, and killing them); 1885: *W.C.*

Obs. A very pretty species, having affinity with *M. taylorianum*, Mitt., and *M. monilinerve*, Nees.

2. *M delicatulum*, sp. nov.

Plant small, procumbent, creeping; stems ½ – 1½ inches long, less (with leaves) than ½ line wide, dichotomous, having a jointed appearance. Leaves minute, pinnate, pale-green, somewhat thickish and opaque, free, rarely laxly imbricate, slightly convex, obliquely oblong-quadrate, sub-falcate, spreading, truncate at tips and coarsely 3-dentate, dorsal margin arched, ventral straight; cells minute, annular, distinct in parallel lines alike throughout (much as in *M. novæ-zealandiæ*). Stipules free, small, very membranaceous, light-reddish-brown, sub-quadrate, 3–5-fid; segments straight or slightly curved; cells large. Flagellæ few and short. Fruit not seen.

Hab. On trunks of tree-ferns, shaded wet woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs.—A peculiar finely-cut soft and delicate-looking plant, forming close and thickish patches through continuously overgrowing; having pretty close affinity with *M. taylorianum*, but differing in its free leaves with orbicular separate cells that are alike throughout, and in its quadrate laciniate membranaceous stipules. I have not yet found it in fruit; and for a long time I had supposed it might prove to be a species of *Lophocolea*, owing to its being barren and my not meeting with a single imbricating branchlet.

3. *M. quadratum*, sp. nov.

Plant small, tufted, sub-erect; stems ¾ – 1 inch long, once forked, and loosely dichotomously branched; grass-green. Leaves close, laxly imbricate at bases, pinnate, falcate, sub-oblong-quadrate, broadest at base, lateral margins slightly uneven or sub-sinuate-dentate, the upper one much arched, the lower straight, short, tip truncate and 3-dentate; teeth large, acute, cellular; cells small, orbicular, larger and oblong-orbicular in centre of leaf. Stipules free, large, quadrate, emarginate, toothed on three sides but most so at top, reddish-tipped. Flagellæ numerous, slender, short.

Hab. Among mosses, etc., on prostrate rotten trunks, damp woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species having pretty close affinity with the two preceding, and presenting a similar appearance; but widely differing in form of stipules, etc.

4. *M. fugax*, sp. nov.

Plant small, 1–2 inches long; stems procumbent and sub-erect, straggling, much branched; branches rather distant, long, filiform, few-leaved, naked below. Leaves alternate, obliquely oblong, broadest at base, amplexicaul, $\frac{1}{36}$th of an inch long, entire, tip broad, very obtuse (sometimes slightly retuse and sub-sinuate), upper margin much arched and very slightly imbricating towards base, the lower straight; pale-green; very fugacious. Cells small, orbicular, with a central longitudinal band of larger ones, increasing in size from apex to near base. Stipules very minute, free, sub-palmate, 4-laciniate; nearly all laciniæ subulate and highly cellular.

Hab. On bark of living trees, among other small *Hepaticæ;* wet woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A small wiry-looking species, having affinity with *M. convexum*, Lind., a Cape of Good Hope species, and also approaching *M. australe*, Lind., a Fijian species. It has rather a ragged look, especially when compared living with the three foregoing New Zealand species; mainly through the easy falling-off of its leaves, which happens with the most careful handling, probably owing to their excessive thinness from the large cells at their bases.

5. *M. similis*, sp. nov.

Small, stems about 1 inch long, dichotomous; branchlets short, divergent. Leaves pale-green, somewhat distant, rarely overlapping at base, flat, spreading, obliquely oblong-quadrate, 3- (sometimes 2-) dentate, teeth short, obtuse; dorsal margin much arched, broad and rounded at base, irregularly sinuate towards apex; ventral margin slightly irregularly sinuate; cells small, confused, with a band of larger ones running from base towards apex within the ventral margin. Stipules free, small, sub-quadrate, 4-fid, largely cellular; segments very long and capillary.

Hab. Forests near Norsewood, County of Waipawa; among other small *Hepaticæ;* 1885; W.C.

Obs. A species having close affinity with *M. taylorianum*, Mitt., but differing in its leaves being distant and much broader at their bases, with sub-sinuate margins, and obtuse and short apical teeth, and also in its stipules being sub-quadrate and largely laciniate, with long cellular capillary segments. Only a few broken specimens were found, mixed among other *Hepaticæ*,

Genus 24. **Fossombronia**, Raddi.

1. *F. rosulata*, sp. nov.

Plant very small, gregarious, creeping at roots, and forming minute mounds, rising in little separate erect rosulate heads very close together, 1½–2 lines high, and about the same in diameter; stem 0; rootlets numerous, purple, matted. Leaves compact, semi-orbicular, sessile, much waved and crumpled, sub-papillose, margins entire, yellowish-green; cells large, broadly-oblong. Perianth very similar, but much smaller, margins slightly and distantly crenate; marginal cells minute, orbicular. Fruit-stalk stout, erect, 5 lines long. Capsule globular, rather large, reddish-brown, minutely reticulately veined, and sub-papillose on the outside, bursting very irregularly.

Hab. Among other *Hepaticæ* and mosses on damp, shaded, clayey cuttings; sides of highway, near the bridge over the River Mangatawhainuī, Seventy-mile Bush, County of Waipawa; 1880–85: *W.C.*

Obs. A very minute plant, nearly allied to the other two published New Zealand species, *F. pusilla*, Nees, and *F. intestinalis*, Tayl.; and also, though more distinctly, to *F. nigricaulis*, mihi (*infra*). It has been long known to me in a barren state, and although often sought in a fruitful one, has only during the summer of 1884–85 been detected bearing fruit.

2. *F. nigricaulis*, sp. nov.

Plant procumbent, creeping, 1–1½ inches long, linear, obtuse, largest specimens 3–4 lines broad at top, shortly branched, branches and tips ascending. Stems stout, dark-brownish-black, densely clothed below with thickish dark-red roots. Leaves pale-green, thin, sub-papillose, broadly oblong, somewhat sub-quadrate at apices, much waved and crumpled, those below a little apart and very decurrent on upper side of stem, giving it a sub-pinnatifid appearance, those at tips crowded, margins thin, entire; cells large, oblong. Involucral similar but smaller, extending (rosulate) around stem and base of fruit-stalk; cells very large. Fruit-stalk 4–6 lines long; capsule globular, reddish-brown, bursting irregularly; sometimes two together, or near each other on top of stem.

Hab. Cliffy sides of road, near the River Mangatawhainui, Norsewood, County of Waipawa; 1884–85; *W.C.*

Genus 25. **Noteroclada**, Taylor.

1. (?) *N. lacunosa*, sp. nov.

Plant prostrate, appressed, spreading, branched; rootlets small, many, closely adhering to the soil; branches 1–2 inches long, 8–10 lines broad, pinnatifid, midrib stout but obscure sub-succulent, brittle, glabrous; colour a pleasing dark grass-green.

Lobes large, 4–5 lines long, 2–3 lines wide, nerveless, not extending to midrib, very close and sub-imbricate, sub-orbicular and broadly elliptic, thin, transparent, finely papillose, studded with pale yellow dots, most so on basal margins; margins entire; the large apical portion of the lobe smooth, flat, and spreading laterally, the basal portion concave with margins raised above midrib, sub-erect, and transversely corrugated almost regularly, thickened and recurved, and having a deeply lacunose appearance; in each posterior axil of those lower cavities on the upper surface is a small cluster of reddish-tipped antheridia (immature) with green paraphyses intermixed. Cells of lobes numerous, large, irregular sizes, sub-quadrangular.

Hab. Scattered in small patches on wet shaded banks, sides of streams and watercourses, among other *Hepaticæ;* low woods, Seventy-mile Bush, County of Waipawa, 1880–85: *W.C.*

Obs. This is a very striking plant, resembling no other known to me among all our numerous endemic plants of this order. Its large size, remarkable fresh and regular semi-ribbed appearance, and dark colour, arrests the eye at once. It has caused me "a world of trouble," extending over several years, in my endeavouring to obtain it in fruit; hitherto, however, I have failed, although I have diligently visited its marked habitats at all seasons of the year, save mid-winter, when I suspect it bears fruit. Not having detected it in fruit, I am not certain of its proper genus; but of all the known genera of *Hepaticæ* this plant is more closely allied to *Noteroclada*, in which I have provisionally placed it; also, though more distantly, to *Fossombronia*, a cognate genus; from which genus, however, its round leaves or lobes exclude it. It is by no means plentiful, only occurring here and there and at distant spots in single small patches, but always presenting a uniform healthy, strong, flourishing appearance. Having sought it so long and so frequently in the fruiting state, without success, I now make it known in its barren form.

Genus 26. **Petalophyllum**, Gottsche.

1. *P. macrocalyx*, sp. nov.

Plant gregarious, minute, 2–3 lines diameter, 1–2 lines high; stem stout, very short scarcely any, dark-red-black, with many fine short red spreading rootlets. Leaves few, sub-rotund, waved and crumpled, margins entire; cells large, sub-quadrate. Perianth large, sub-campanulate, erect, 2 lines long, 1¼ lines broad, whitish, margin entire. Fruit-stalk 12–14 lines long, slender, capsule globular, brown, splitting irregularly into four divisions, each sub-cuneate, obtuse, 2–3 lobed.

Hab. Among mosses and small frondose *Hepaticæ*, damp sides perpendicular cuttings on the roadside, Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A very minute plant, wholly hidden but for its large erect inflated whitish perianth.

Genus 27. **Zoopsis,** Hook. fil. and Tayl.

1. *Z. flagelliforme*, sp. nov.

Plant slender, prostrate, glabrous, glistening, light-green; $\frac{3}{4}$ – $1\frac{1}{2}$ inches long, $\frac{1}{40}$th of an inch broad, much and dichotomously branched; main branches linear-lanceolate, flexuous, composed of two rows of cells on each side of the central cord, tips flagellate; sides sinuate with sub-rotund or knobbed projections of large blunt cells, sub 3, or so, together, alternate and at almost regular distances, with smaller cells intervening, and a few scattered short and simple rootlets beneath peeping. Involucral scales long, irregular, lanceolate. Perianth large, lateral, pedicelled, highly cellular, almost cancellate, much laciniate; laciniæ long, each composed of two rows of large orbicular cells; also some of a single row of oblong cells; pedicel thick. Fruit-stalk 2 lines long, septate, cellules large and full of scattered dark dots; capsule light brown, oblong; valves oblong-lanceolate, obtuse, excessively reticulated with dark veins, the longitudinal ones thick and wavy.

Hab. Among other *Hepaticæ* on decaying logs; wet forests, Norsewood, County of Waipawa; 1885: *W.C.* (Same localities; October, 1885: *W.C.*

Obs. A species having pretty close affinity with the only other known (published) species of this genus, *Z. argentea*, Hook. fil. and Tayl., but differing from that species in its larger size yet narrower; in being much branched, with flagellate tips; in shape, and in colour, and in the number, form, and position of its cells. A truly elegant object under a misroscope.

2. (?) *Z. lobulata*, sp. nov.

Plant minute, tufted, glabrous, stems brownish, creeping, 3–4 lines long, dichotomous, sub-bipinnatifid; branchlets or lobes sub-erect, linear, almost filiform, about 1 line high, emarginate, margins entire; cells sub-orbicular, apparently 2–3 nerved; light-green. Perianth lateral near base, short, laciniate, thickish, opaque, brownish-red. Calyptra sessile, sub-obovate, very membranaceous, reticulate, bearing a small reddish cellular boss or umbo on the top, which is persistent. Capsule shortly pedicelled, oblong, on a short, thickened, linear-oblong (or apophysate) stem, striate, bursting at tip, mouth conniving. Spores green, orbicular, trilobed. Elaters long, pointed and spiral, remaining fixed in an irregularly pencilled mass at mouth.

Hab. On denuded rotten logs, in large continuous patches; shaded wet forests, near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. It is with some doubt that I place this new, curious, and interesting little plant under *Zoopsis*, as it possesses some only of its characters. Sir J. D. Hooker had only seen "immature fruit" of the one species on which he established that genus. This plant, however, is very distinct from that one, and also from *Z. flagelliforme*, mihi (*supra*), and may yet become the type of another genus.

Genus 30. **Symphyogyna**, Mont. and Nees.

1. *S. brevicaulis*, sp. nov.

Plant epiphytical, closely gregarious, pendulous and imbricated in growth, rhizome creeping, rough, spongy, light-brown, villous. Frond light grass-green, glabrous, mostly simple, linear-oblong, about ½ inch long, 1–2 lines wide, sometimes but rarely forked, much waved, margins entire, tips retuse, broad at base and shortly decurrent or truncate, midrib thick; stipe very short, with fine red hairy rootlets at base; cells large, of various sizes, sub-quadrate. Involucre central, sometimes 2–3 on a single frond, and when the frond is forked not at the forking, small, deeply laciniate, laciniæ very narrow. Calyptra long, tubular, sub-clavate, striate, rather loose and sub-plaited, lips entire, bearing a few scattered reddish pistillidia. Fruit-stalk short, often two very near each other. Capsule 1 line long, cylindric, obtuse, finely striate, purple-black; spores circular, dark purple-brown; elaters very numerous, long, bi-spiral, flexuous.

Hab. Clothing the stem of a fern tree (*Dicksonia squarrosa*), in a deep-shaded forest near Norsewood, County of Waipawa; 1884–85: *W.C.*

Obs. A species near to *S. sub-simplex*, Mitten, and to *S. simplex*, Colenso, ("Trans. N.Z. Inst.," vol. xvi., p. 352,) especially in its barren fronds, but very distinct in its characters.

Genus 32. **Aneura**, Dumort.

1. *A. muscoides*, sp. nov.

Plant light-green, in dense, small-moss-like effigurate subcircular patches, 5–6 inches diameter; excessively compact and uniform. Fronds minute, erect, sub ½ inch high, simple, rarely forked, compressed, linear-cuneate, under ½ line wide, broadest at tip, margins sinuate, and very shortly and sparingly lobed or knobbed; tip 1–2 notched, or truncate; green above at apex, white below at base.

Hab. Sides of wet cliffs, and closely adhering to them; River Mangatawhainui, near Norsewood, County of Waipawa; October, 1884: *W.C.*

Obs. This little plant wears a most peculiar appearance, more like a thick patch of densely growing *Conferva*, or a piece of green plush cloth! Although presenting such a close rigid

aspect, and when gathered with unbroken base it adheres closely together, yet on the basis being cut it falls directly into separate fibrils or fronds. Growing with it and scattered among it, and just as closely compacted and regular in height, is another small *Hepatica*, *Gymnomitrium orbiculata*, mihi (*supra*).

2. *A. pellucida*, sp. nov.

Plant low, creeping, forming large, compact, small-moss-like patches on branches of living trees, densely imbricate, regular in height and in general appearance, 3–4 lines high, bi-tri-pinnatifid, rather thickish, succulent, very fragile, bright emerald-green, shining; main branches concealed, flat, broad, adhering strongly by many minute rootlets; branchlets opposite, sub-erect, sub-palmate, many lobed; lobes short, broadly linear, entire, obtuse and emarginate, the broadest minutely crenulate at tip, sub-pellucid; cells large, sub-orbicular, very close, apparently disposed in a double layer and beaded. Calyptra cylindrical, 1½ lines long, white, transparent, rugose; cells large and oblong, also having a beaded appearance. Seta very slender, weak, hyaline, shining, ½ inch long. Capsule, valves linear, acute, spreading, finely striate longitudinally; pencils of elaters at tips patent with a sub-rigid appearance, bi-spiral, acicular at tips.

Hab. On branches of living trees; wet shady woods, near Norsewood, County of Waipawa; 1876–1885: *W.C.*

Obs. A small, low, spreading, mossy-looking plant of a lively green colour, not unfrequently met with on the branches of the smaller forest trees with smooth bark, (as *Melicytus*, the larger species of *Coprosma*, *Weinmannia*, etc.,) in wet shaded woods, but rarely ever found in fruit. Indeed, I never detected any fruiting specimens until this autumn (April, 1885). It is altogether a charming object under a miscroscope from its transparency, the apparent regularity of its growth, in the length, height, and direction of its minute fronds, (all, too, severally more or less irregular,) is very remarkable. It has close natural affinity with the following species, *A. crispa*.

3. *A. crispa*, sp. nov.

Plant prostrate, spreading in effuse dense patches, 4–5 inches long; 2–3 pinnatifid, closely imbricate, dark-green. Fronds or lobes about ¼ inch high, sub-erect, ascending, much cut and irregularly laciniate; calyptra white, sub-clavate, tubercled, erect and curved, 2 lines long, rising above the plant, and so presenting a novel appearance; fruit-stalk very slender; capsule rather long, linear-oblong; valves narrow, bearing elaters largely at their tips.

Hab. On rotten logs, shaded and damp spots, base of high cliffs, banks of River Mangatawhainui, near Norsewood, County of Waipawa; October, 1884: *W.C.*

4. *A. epibrya*, sp. nov.

Plant thickish, brittle, softish, light-green, mostly composed of single irregular-shaped sub-erect fronds, that are sometimes forked and slightly branched or lobed, and sometimes overlapping, 1–1½ inches long, 3–4 lines wide, broken below, arising from a decaying base. Fronds sub-solitary, linear-oblong, expanded and rounded at tips, waved, rumpled, and incurved, margins entire, thin, slightly and irregularly crenulate, usually more so at tips; semi-transparent when fresh, largely so when dried, with short, yellow, silky hyaline rootlets below, by which it adheres strongly to its supporting moss; cells obscure. Calyptra stout, erect, 3½ lines long, green, bristly and rough, with short patent hairs.

Hab. Epiphytical on *Hypnum aciculare*, dry shaded declivities, *Fagus* forests near Norsewood, County of Waipawa; 1883–85: *W.C.*

Obs. A peculiar species, confined (as far as I have observed) to this one species of large, erect and very dry moss, which it sometimes kills; its fronds are of vigorous growth, but are almost invariably rotten at their bases. In its strange habitat (for a plant of this genus that delights in low, wet and shaded localities,) it is plentiful, though always scattered, from its so early decaying at base. It is allied to *A. biflora*, Col.,* which species is also epiphytical on living moss (*Hookeria*), but that moss is only found in wet, dark shaded localities, and is also sub-succulent.

5. *A. marginata*, sp. nov.

Plant small; main stems creeping, prostrate, dark red-brown; branches generally simple, sometimes forked, erect, densely tufted, 3–4 lines high, linear, sub-clavate, occasionally somewhat palmate, margined; margins entire, sometimes (but rarely) slightly denticulate and sub-lobed, tips emarginate; succulent, sub-rigid; green. Cells large, sub-orbicular, sparsely beaded, those of margin small and very regular. Fruit single at base of lobe below. Calyptra cylindrical, erect, 1½ lines long, sparingly tubercled below, more so above, and crowned with a boss of tubercles; tubercles red, obtuse, cellular. Capsule oblong, dark-blue.

Hab. On rotten logs in low wet woods, forming close and large patches; forests near Norsewood, County of Waipawa; 1885: *W.C.*

6. *A. nitida*, sp. nov.

Plant minute, creeping, imbricate, reclinate, densely tufted, crisp and brittle, of irregular growth; yellowish-white. Base stems, or main branch of frond, broad, flat, strongly adhering,

* *Vide* "Trans. N.Z. Inst.," vol. xvii., p. 262.

glistening, having a varnished appearance; branches very short, broad, irregular, sub-flabellate, laciniate and deeply lobed; lobes about 1 line long, sub-erect, secund, linear, entire, sometimes slightly sub-denticulate, spreading; tips obtuse. Cells rather large, oblong, numerously beaded. Fruit-stalk lateral at sinus of lobes, single, sometimes 2–4 on a branchlet; involucral scales 2–4, small, broad, acute and spreading. Calyptra white, slender, 1 line long, very sparsely tubercled throughout; tubercles very fine almost hairs, white. Capsule very narrow, linear-oblong, slender.

Hab. In low wet woods near Norsewood, County of Waipawa; 1885: *W.C.* On rotten logs forming large yellow patches, adhering very strongly as if gummed on; difficult to separate even when long steeped in water.

Obs. A species similar to the preceding, *A. marginata*, but differing in colour, habit of growth, not being margined, cells oblong and confused; calyptra white, more slender, and not coarsely and red tubercled; and the main stems broad, flat, and glassy.

7. *A. punctata*, sp. nov.

Frond small, greenish-white, thickish, sub-erect, 3–6 lines high, effuse, usually somewhat broadly palmate, spreading, much branched and lobed; branches very short, sub-pinnatifid or lobed, retuse, irregular; cells oblong, large. Calyptra erect, 1 line long, cylindrical, sub-clavate, contracted at mouth, white, smooth, cellular, sub-transparent; cells linear-oblong, minutely beaded with round dark dots. Fruit-stalk slender, $\frac{1}{2}$ inch long, hyaline, transversely septate. Capsule rather small, oblong, dark purple-brown, finely striate, closely and minutely transversely barred or dotted with black, valves obtuse, margined; elaters long, bi-spiral with acute tips; spores circular.

Hab. Among other *Hepaticæ* on rotten logs, forming thick little patches, wet woods near Norsewood, County of Waipawa; 1885: *W.C.*

Genus 39. **Anthoceros**, Micheli.

1. *A. granulata*, sp. nov.

Plant prostrate, spreading in effuse patches, 5–6 inches long, closely adhering by its numerous fine hair-like rootlets, densely imbricate, light-green, and covered with masses of fine sparkling granules, as if frosted (or like soredia in some species of *Parmelia*); lobes at first very small and irregular, large and concave in age, with rounded crenulate margins. Calyptra conical, thick and sub-globose at base, and slightly tubercled; peduncle $\frac{1}{2}$–$\frac{3}{4}$ inch long, erect, green; capsule $\frac{3}{4}$ inch long, dehiscing to base at one side only, brown; valves flexuous, broad and flat; columella very slender.

Hab. On rotten logs, growing with *Aneura crispa* (*ante*), shady bases of cliffs, River Mangatawhainui, near Norsewood, County of Waipawa; November, 1884: *W.C.*

Obs. Before fruiting the fronds are very soft, and are then easily mistaken for some other allied frondose genus of *Hepaticæ.*

2. *A. membranaceus*, sp. nov.

Plant prostrate, spreading in small irregular patches, sub-imbricate, green. Lobes variously shaped, mostly obovate-oblong, 4–8 lines long, sub-pinnatifid; lobules rounded very much and finely cut (sub-laciniate-fimbriate), very thin, abounding in reticulate cells under a lens. Calyptra conical, roughish, green below, brownish at tip, 3 lines long; peduncle slender, green, 6–8 lines long; capsule about ½ inch long, very slender, light-brown, diverging at tips; valves separate to base; columella very filiform, flexuous; spores orbicular, muricated; elaters flexuous, bi-spiral.

Hab. On logs in wet dark woods, near Norsewood, County of Waipawa, growing underneath large *Aneura*, &c.; November, 1884: *W.C.*

Obs. A species remarkable for the smallness of its fronds, and the number of its fruit-stalks, the fine hair-like slenderness of its receptacle, and the light-red colour of its capsule.

3. *A. pusilla*, sp. nov.

Plant very small, densely gregarious in effuse patches of 3–4 inches, erect, glabrous. Fronds 3–4 lines high, 2–2½ lines wide at top, broadly cuneate and sub-fan-shaped, lobed, laciniate; upper margin crenulate and crisped, thickish, succulent, pellucid; apical portion light-green; pale below, covered with scattered minute green specks, and a few small white rootlets near the base; cells large. Calyptræ 1–2–3 on a frond, rising from the centre, cylindrical, 2 lines long, bulbous at base, smooth, entire at margins; capsule 3–4 lines long, slender, green; tips black. Gemmæ scattered in substance of frond, in rather large dark coloured elliptic bodies.

Hab. Among mosses and *Hepaticæ*, bases, wet sides of steep clayey cuttings, public roads; Seventy-mile Bush, County of Waipawa, 1885: *W.C.*

Obs. A species having some affinity with *A. muscoides*, mihi ("Trans. N.Z Inst.," vol. xvi., p. 361), but smaller, with fewer and very much shorter capsules, etc.

"Qui quo destinavit vult, unam sequatur viam, non per multas vagetur.—Non ire istud, sed errare est." (Seneca, *Epist.* xlv.)

Art. XLIV.—*A Description of some newly-discovered and rare Indigenous Plants: being a further Contribution towards the making known the Botany of New Zealand.* By W. Colenso, F.L.S., etc.

[*Read before the Hawke's Bay Philosophical Institute, 14th December*, 1885.]

Class I. Dicotyledons.

Order I.* RANUNCULACEÆ.

Genus 3. **Ranunculus**, Linn.

1. *R. ruahinicus*, sp. nov.

Erect, stout, 2 feet high, paniculately branched, many flowered, thickly pilosely-villous, light-green with a yellowish tinge; hairs mostly short, pale reddish-brown. Leaves orbicular, $4\frac{1}{2}-5\frac{1}{2}$ inches broad, coriaceous, upper surface slightly hairy, with long strigillose hairs; under surface much more hairy, the hairs shorter, and springing singly from pits or minute depressions in the lamina, but long and thick on the veins; 10–12 ribbed, ribs extending to margin, stout, prominent below; much reticulately veined; margins crenately-serrate (usually 1 broad crenature and 1 smaller and more acute one), each with a small dark-brown raised point or knob at the apex end of a vein; sparingly sub-lobed, lobes 3–4 lines deep and over-lapping; edges thickly ciliate; sinus broad diverging; petiole stout, 4–5 inches long, 3 lines wide, hairy like under-surface of leaf, sheathing at base with a pair of broad membranous stipules. Peduncle stout, 2 lines wide, cylindrical, fistular, with a whorl of three cauline linear-lanceolate sessile bracts, $1\frac{1}{2}$ inches long, 4 lines wide, 3-nerved, thickish, with a few scattered hairs on the upper surface, margins entire and much ciliate; pedicels 4, sub-fasciculate, each 4 inches long, sub-angular, bi-bracteolate about the middle; bracts sessile, linear, 8–9 lines long, diverging. Flowers bright glossy yellow (rather pale, not dark) on the face, paler and dull, with a tinge of green, on the back; $1\frac{1}{4}-1\frac{1}{2}$ inches diameter. Sepals 5 (similar in colour to the petals on the back), broadly ovate, $\frac{1}{2}$ inch long, very concave, hairy, strongly and coarsely veined, almost ribbed; 3 principal veins at base soon branching into 8–9 longitudinal ones; tip thickened obtuse emarginate green; margins very thin and largely ciliate. Petals (always) 5, large, broadly cuneate, with scarcely any claw; 7 lines wide at top and about 8 lines long, spreading, wavy, margins reflexed, emarginate, obsoletely nerved (nerves prominent in dried specimens), with one broad stout glandular depression having a ridged margin close to base. Anthers very

* The numbers in this paper attached to both Orders and genera, are those of the "Handbook of the New Zealand Flora."

numerous, rather small, elliptic, obtuse, with a minute connective; stamens somewhat clavate, or with the anther subspathulate. Heads small, broadly ovate; receptacle elongated, glabrous, finely papillose. Achenes (immature) long, narrow, subulate, erect, slightly hairy below; style scarcely recurved, glabrous; tip (stigma) minutely pencilled.

Hab. On spurs of the east slopes of the Ruahine mountain range, County of Waipawa; November, 1885: *Mr. H. Hill.*

Obs. A fine and striking species, but closely allied to *R. insignis*, Hook. fil.; differing, however, in its smaller size; orbicular strigillose leaves; larger, ribbed, and ciliated sepals; fewer, deeply emarginate, broader and rumpled petals; and especially in their possessing but a *single* glandular depression—*R. insignis* having more (2, "Flora N.Z.;" 3,* "Handbook" ditto); on which grave characteristic stress is also laid—and also in the form and construction of the anthers. It is, however, worthy of note, that *R. insignis* is a denizen of the higher summits of this mountain range (where it was originally discovered by me), while this plant is found on the lower spurs of the same range.

ORDER VI. CARYOPHYLLEÆ.

Genus 2. **Stellaria**, Linn.

1. *S. oligosperma*, sp. nov.

A slender prostrate rambling flaccid creeping and glabrous herb, 1 foot or more long, growing in pretty large entangled patches of many feet, rooting from its nodes. Leaves few, distant, opposite in pairs, very thin, light-green, orbicular, 2–2½ lines diameter, with intra-marginal parallel vein, apiculate, petioles slender, longer than leaves, with a few weak hairs. Peduncles axillary, much longer than leaves, patent, two-flowered; pedicels 4–6 lines long, unequal in length though springing from the same base, erect and divergent at right angles with a pair of bracts at their base, and another pair below the middle of the longer pedicel; bracts ovate-acuminate, scarious with a dark central line. Flowers 1½ lines diameter; sepals 5, ovate-acuminate, 1-nerved with white scarious margins; petals 5 divided to base, each lobe linear-spathulate; stamens usually 9; styles 3, large, flexuous; capsule twice the length of sepals, very membranous, white, 6-valved nearly to base, valves reflexed; seeds few and large, usually 6, sometimes fewer, orbicular, turgid, with a notch, bright cinnamon-coloured when first ripe, becoming dark-brown with age, finely and regularly marked somewhat concentrically, not pitted.

* Can this "3" be an overlooked "printer's error"? as two only are shown in the admirable plate in "Flora Novæ Zelandiæ," and also twice repeated in the description.

Hab. In shaded forests, near Norsewood, County of Waipawa; 1883–85: *W.C.*

Obs. A species having pretty close affinity with *S. parviflora*, Banks and Sol., which it resembles in habit, but differing in several particulars.

Order XVII. STACKHOUSIEÆ.

Genus 1. **Stackhousia**, Smith.

1. *S. uniflora*, sp. nov.

Plant small, glabrous; stems creeping underground; branchlets numerous, slender, sub-angular, erect, loosely branched, light-green, with reddish striate lines, 1–2 inches high; leaves small, few, distant, 6–10 on a main branch, linear-obovate and broadly-lanceolate, 1½–2½ lines long, acute and sub-apiculate, thickish, nerveless, green with reddish margins, sub-petiolate with minute stipellæ. Flowers terminal, solitary, conspicuous, rather large for the plant, peduncled with one small foliaceous bract at base; calyx lobes adpressed, deltoid, serrulate and very acute; corolla 2–2½ lines long, yellowish-brown, speckled and striped with red (as also the calyx), tube united nearly to base, lobes more dusky and dark spotted, linear-lanceolate, acute, 1 line long, spreading, sub-revolute; anthers glabrous, oblong, subacute, cordate, orange; stigma trifid; cocci (immature) 3.

Hab. On open spots, banks of the River Manawatu, County of Waipawa; November, 1884: *Mr. Henry Hill.*

Obs. A species allied to *S. minima*, Hook. fil., our only known New Zealand species, but differing from it in its flowers being always solitary, its adpressed calyx with serrulate lobes, and its glabrous anthers. It is also closely allied to *S. pulvinaris*, Muell., (judging from Bentham's description of that species in his "Flora Australiensis,") an Australian and Tasmanian plant of nearly the same size and habit; which species, however, has crowded leaves almost concealing the flowers, obtuse lobes to the corolla, and small obtuse bracts.

Order XVIII. RHAMNEÆ.

Genus 1. **Pomaderris**, Labill.

1. *P. amœna*, sp. nov.

Shrub 2–3 feet high, bushy, diffused, much branched, very leafy; stems and branches dark-red-brown; branchlets thickly hirsute-pubescent with patent grey hairs. Leaves numerous, close set, thickish, patent, sub-decurved, 2–3 lines long, linear, obtuse, wholly revolute laterally to midrib; margins entire, meeting, of a pleasing grass-green colour above, and very scabrid (sub-muricate) with white scattered hairs; petioles pubescent, nearly 1 line long, and very striking from their white

colour with a yellowish tinge; stipules two or more, half the length of leaves, subulate, erect, grey. Flowers very numerous at tops of branches, in small axillary cymose-panicles of 6–8 flowers, twice the length of leaves; pedicels about 1 line long, each with two scarious brown bracteoles at base. Petals 0. Calyx large, spreading, rotate, white, petaloid, 2 lines diameter, pubescent on outside (with pedicels and peduncle), lobes broadly ovate, reflexed, with a central ridge the whole length above, margins incurved, apices sub-acute, thickened; stamens spreading and inclined, a little longer than the style, brown; anthers oblong, obtuse, light-brown; style very short, fuscous, 3- (sometimes 2-) branched; branches long, spreading, clavate; stigma large, globular, papillose, dark-brown, ovary half exserted, subconico-rotund, thickly villous with long, whitish, shining hairs; cocci 3, narrow elliptic, obtuse, concave.

Hab. Growing with *Leptospermum*, on dry, open, hilly grounds, back of Poverty Bay; 1885: *Mr. H. Hill.*

Obs. A species certainly very new to the common northern New Zealand species (*P. phylicifolia*, Lodd.), but differing from it in several characters, the most striking being its bright-green foliage, (which colour it also retains in drying,) and its longer panicles of much larger flowers, that are spreading, very white, and conspicuous; an entirely different looking plant from its northern congener.

ORDER XXVII. HALORAGEÆ.

Genus 1. **Haloragis**, Forst.

1. *H. minima*, sp. nov.

Plant very small, glabrous, wiry, prostrate and creeping, rooting at nodes; root-stock and rootlets glabrous; branches ascending, 1–2 inches high, few (4–6) leaved. Leaves opposite, sub-orbicular and orbicular-ovate, not cordate, apiculate, about 1 line long (sometimes, but rarely, 1½ lines), crenate or inciso-serrate with minute coloured teeth 2–6 to a leaf, thickish, nerveless, light-green. Flowers very minute, scarcely ½ a line long, simple-panicled and racemed at ends of branches, opposite in pairs, lowest pair very distant from the rest on peduncle, upper ones crowded, pendulous on short pedicels, axillary, springing from simple entire foliaceous green bracts or floral leaves, with very minute coloured bracteoles at base of pedicels; calyx-tube sub-globular or turbinate, 8-ribbed, glabrous, shining, dark-red; lobes large, deltoid, green with purple margins; petals boat-shaped, conniving, apiculate, dark-purple-red, anthers exserted, oblong, obtuse base and tip; stigmas very plumose; fruit not seen.

Hab. Tarawera, high lands between Napier and Taupo; December, 1884: *Mr. H. Hill.*

Obs. A species pretty closely allied to its small New Zealand congeners, *H. depressa*, Hook. fil., and *H. micrantha*, Brown; and also to some of the smaller Australian and Tasmanian forms, but is abundantly distinct in many particulars.

Genus 3. **Gunnera**, Linn.

1. *G. flavida*, sp. nov.

Plant glabrous, erect, 3–4 inches high; leaves 7–9, radical, membranous, broadly elliptic, $\frac{3}{4}$–1 inch long, margins sinuate-crenulate, petioles 1–2 inches long. Scape erect, very stout, much longer than leaves (about 4 inches), springing from root-stock below leaves. Flowers not seen. Fruit in a spike (or sub-raceme) 2 inches long, drupes fleshy, $1\frac{1}{2}$–2 lines long, sub-turbinate, compressed, patent, light yellow, scattered and pedicelled below, sub-sessile and pretty close together above.

Hab. Swampy ground near Tahoraiti, County of Waipawa; April, 1885: *Mr. H. Hill.*

Obs. A species having some affinity with *G. prorepens*, Hook. fil., but differing in several characters, as size and form of leaves and petioles, length of scape, and position, shape, and colour of ripe fruit; which in *G. prorepens* are sessile, very compact, and bright-red. I have received, through the kindness and courtesy of Mr. Hill, several good and whole specimens, and they do not vary.

Order XXXIII. UMBELLIFERÆ.

Genus 1. **Hydrocotyle**, Linn.

1. *H. colorata*, sp. nov.

Plant hirsutely-pilose; stems stoutish, 1–2 feet long, creeping, rooting at nodes 1–2 inches apart, usually one leaf and one peduncle bearing flowers from each node. Leaves pale-green, often purple-margined, soft, rough above with muricated points and white sub-succulent strigillose hairs, 8-10 lines diameter, orbicular-reniform with a very broad sinus, 7-veined, 5-lobed (the two outer lobes being larger and sub-lobed), lobes cut $\frac{1}{3}$rd to middle, each acutely and many toothed; petioles very long, 3–5 inches; stipules rather large, membranous, shining, coloured pink, sharply laciniate. Flowers: peduncles $\frac{3}{4}$–1 inch; heads small, globular, many-flowered, 15–30; petals broadly-ovate, acute and concave, whitish-yellow streaked with red on the outside, pinkish within, very shortly pedicelled; bracteoles small, linear-spathulate, obtuse, appearing above flower-buds and covering them before expansion, and persistent. Fruit very small, $\frac{1}{16}$ inch diameter, glabrous, chestnut-brown; styles distant, much recurved; carpels somewhat turgid, with a narrow ridged rib on each face; back acutely ridged; dark-brown when fully ripe, persistent.

Hab. In low spots, margins of woods near Norsewood, County of Waipawa; 1884–85: *W.C.*

Obs. I. This plant forms large dense patches, overrunning all low herbage, roots, twigs, etc., in a very tangled way; it has, however, a pretty uniform and striking appearance from its pale colour and neat leaves. It grows profusely in three or four spots in the locality named, but I have not observed it anywhere else.

Obs II. This species has some affinity with *H. moschata*, Forst., also with *H. compacta*, A. Rich., (another New Zealand species,) and probably with some Australian and Tasmanian species (as *H. hirta*, Br.), judging from diagnoses of Hook. fil., and Bentham; but, in my opinion, is very distinct, and one not readily confounded with our many New Zealand species.

2. *H. alsophila*, sp. nov.

Plant weak, glabrous, prostrate, creeping, much entangled; stems 1–2 feet (or more) long, rooting at nodes. Leaves rather distant on stems, 1 inch or more apart, membranous, bright green, sub-orbicular-reniform, 9–14 lines diameter, 8-veined and lobed, the four central lobes large and rounded at tips almost entire, or each lobe having three blunt crenate-serratures, the two outer lobes crenate-toothed at base; sinus large; lamina reticulate; petioles 2½–3 inches long, nerved, with a few long flaccid succulent jointed white hairs immediately under the leaves, each one enclosed in a pellucid tubular membrane; stipules large, very membranous, largely and finely reticulated, margins entire. Peduncles very short, about 2 lines long, stoutish; umbels 9–11 flowered (usually 10); flowers small, pedicelled; pedicels short, stout; bracteoles bladdery, obtuse, concave; petals white; styles flexuous, incurved; stigmas stout, largely tubercled. Fruit small, $\frac{1}{20}$th inch diameter, glabrous, very thin, pale yellowish-brown; carpels with one rib on each face.

Hab. In dense dark forests, Seventy-mile Bush, County of Waipawa; 1882–85: *W.C.*

Obs. This plant grows profusely in large patches, extending many yards each way. It seems to be allied to *H. novæ-zealandiæ*, DC., and *H. heteromeria*, DC., but is quite distinct.

ORDER XXXVIII. RUBIACEÆ.

Genus 1. **Coprosma**, Forst.

1. *C. rufescens*, sp. nov.

A tall, slender, erect, distantly branched shrub, 9–12 feet high; bark greyish; epidermis slightly scaly. Branches and branchlets few, very long, slender, opposite, divaricate at nearly right angles, and spreading; branchlets densely hairy, with patent reddish hairs. Leaves few, somewhat scattered, mostly in distant pairs at tips of branches and branchlets, very membranous, sub-rugulose, broadly elliptic, sometimes (but rarely)

orbicular, 6–10 lines long, sub-cuspidate, slightly tapering at base, of a reddish-brown (sometimes of a dark-purple) hue above, pale dull-green below, closely reticulated; primary veins opposite, not extending to margin; margin finely crenulate and slightly recurved, largely ciliated with twisted variegated hairs; very hairy above and below on midrib and veins, with reddish hairs; petioles slender, 2 lines long, densely hairy; stipules hairy, broad, with long cuspidate subulate hard black tips. Flowers: *Male*, very small, under 1 line, hairy, shortly peduncled, 2–3 together; corolla membranous, shallow, cup-shaped, 4-lobed nearly to base; lobes large, spreading, ovate, 1-nerved, recurved; stamens exserted, pendulous; anthers large (for flower), elliptic, whitish: *Female*, single and axillary, but close together in opposite axils, sometimes three together; peduncle short; calyx minute hairy; corolla hairy, 1½ lines long, narrow infundibuliform, mouth 4-cleft, lobes recurved; stigmas 2 lines long, clothed with flattish obtuse scale-like pubescence. Fruit red, didymous, 3 lines broad, 1½ lines long, each half-drupe orbicular; often 2–3 drupæ very close together on opposite sides of the slender branchlets. Seeds globose, 1 line diameter, whitish, smooth, with a fine central ridge on the back, and a small and deep sub-orbicular concavity at their junction, giving them the curious appearance of little rounded univalve shells.

Hab. Scattered on margins of low forests, near Norsewood, County of Waipawa; 1874-85: *W.C.*

Obs. I. I have long known this species of *Coprosma*; but, as it was very rarely ever seen by me in fruit, and never in flower—from its flowering so very early in the spring, before that I should visit those wet and cold forests—and from my supposing it to be one of those already described, I paid no great attention to it. Last year, however, through going thither very early seeking *Hepaticæ* in fruit, I obtained flowering specimens, and this summer its fruit; and now, after patient and long examination, (for its flowers are very small and also scarce,) I have considered it to be a new and undescribed species; certainly, in some respects, pretty near to both *C. rotundifolia*, A. Cunn., and *C. tenuicaulis*, Hook. fil., but I think distinct from both, and from all other described species of this intricate and puzzling genus; its very peculiar seeds serve well to fix it. Some of its leaves are not unfrequently dark-coloured, of a peculiar purple-coppery, semi-bronzed appearance; and this hue sometimes extends to all on that branch or branchlet. The great scarcity of its ripe fruit I attribute to their being early eaten by birds and insects, as they are very fleshy and sweet.

II. I may also observe that the tips of its branches and branchlets often present a very singular appearance. A small, very hairy ball, ½ inch diameter, with a little crown of 3–4 narrow, long, and very hairy leaflets spreading from its summit,

is found there; a curious kind of gall-like excrescence, the work, doubtless, of some insect. A very similar one is also to be met with at the tips of the branchlets of *Hydrocotyle concinna*, Col., mentioned by me in my description of that plant. ("Trans. N.Z. Inst.," vol. xvii., p. 239.)

2. *C. heterophylla*, sp. nov.

Plant a small, slender, erect shrub 4–5 feet high, of irregular and diffuse growth; bark pale-greyish-brown. Branches long, loose, and very slender, thickly pubescent (as are also branchlets, stipules, and petioles,) with short white hairs; branchlets opposite, long, almost filiform, arcuate, few-leaved. Leaves few, scattered, usually in pairs about 1 inch apart, membranaceous, glabrous, light-green above, paler below, spreading, of various shapes and sizes—rhomboidal, sub-orbicular, lanceolate, and narrowly linear, 3–4 lines long, $\frac{1}{3}$ – 3 lines broad, tips acute, veins red and reticulated, margined; margins red and a little recurved, entire and slightly sinuate-crenulate, gradually narrowed into the petiole; petiole short, slender, under 1 line long; stipules very short but broad with a point, sub-ciliated. Drupe lateral, solitary on a short peduncle, generally on the under side of branches opposite to leaves on the upper, and at the outer angles of branchlets, globose, 2 lines diameter, purple-black, glossy, juicy, sweet; calycine lobes at base of drupe persistent, small, deltoid, pubescent, spreading. Nuts very small, elliptic, 1 line long, gibbous, very flat on their sides of junction.

Hab. In thick, dry woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species having affinity with *C. rhamnoides* and *C. divaricata*, A. Cunn., also with *C. concinna*, Col.,* but very distinct. It is a curious and striking plant in its foliage, from their extreme diversity; all the shapes mentioned above being often found on one branchlet. Its long, drooping branches are by far the most slender of all the species of the genus known to me; their being also so very bare of leaves helps to show their extreme tenuity. Flowers not seen; fruit plenty.

ORDER XXXIX. COMPOSITÆ.

Genus 1. Olearia, Mœnch.

1. *O. suborbiculata*, sp. nov.

Leaves sub-coriaceous, alternate, about $\frac{1}{2}$ inch apart, broadly elliptic, $1\frac{1}{2}$–$2\frac{1}{4}$ inches long, obtuse and sub-acute, base rounded and regular, margin entire in the lower half, slightly sinuate in the upper, with a few very small (scarcely developed) blunt teeth, glabrous, green and shining on the upper surface (but

* "Trans. N.Z. Inst.," vol. xvi., p. 330.

when young very pilose, and hairs there deciduous), greenish-white below, and thickly covered with short adpressed hairs, having longer ones scattered among them, veined, veins and midrib prominent below, finely reticulated above; midrib brown; petioles short, sub $\frac{1}{2}$ inch, stout, channelled, half-clasping, decurrent in a ridgy line to the next leaf below; a small orbicular leaf 4–5 lines diameter usually at base of branchlets; branchlets, petioles, midrib and young leaves densely clothed with silky adpressed brown-reddish hairs. Inflorescence sub-terminal and axillary in long loose slender corymbose-panicles, pale-coloured and hairy, 2–3 inches long, three together sub-fascicled or joined close at base with connate bracts at bases, each ultimate sub-panicle containing 3–4 heads on slender, nodding, and bracteolate pedicels, $\frac{1}{4}$ – $\frac{1}{2}$ inch long. Heads $\frac{1}{8}$ inch diameter, narrow, oblong, $\frac{1}{4}$ inch long; involucral scales laxly imbricate in sub 5 rows, outer scattered short brown and very villous, inner close, long, linear, pinkish-green, glabrous in the centres and densely shaggy-ciliate at margins, especially at tips. Flowers: of ray, 8–9, linear, oblong, tips mostly emarginate, white, spreading, sub-revolute; of disk, 6–7, yellowish, lobes broadly-ovate, obtuse, scabrid at tips on outside. Pappus white, rather short, irregular, outer shortest, not thickened at tips, scabrid. Achene small, cylindrical, sub-conical, obtuse, pilose. Receptacle pitted, borders large and ragged.

Hab. Hilly country in the interior, Patea, between Napier and Tongariro Mountain.

Obs. Of this plant I have only received one fair flowering specimen, from Mr. A. Lascelles (who, however, did not gather it himself); it is evidently a branch from a stout shrub, but some allowance must be made for the leaves, which may, lower down, be larger. Its alliance is with *O. nitida*, Hook. fil., and with *O. populifolia*, Colenso, belonging to that sub-section, (*apud* "Handbook N.Z. Flora,") though largely differing from both of those species.

Order LVII. LABIATÆ.

Genus 1. **Mentha**, Linn.

1. *M. consimilis*, sp. nov.

A small sub-erect and prostrate fragrant herb, branches 2–4 inches long, finely pubescent. Leaves few, distant, opposite, petioled, $1\frac{1}{2}$ – $2\frac{1}{2}$ lines long, sub-orbicular, and broadly ovate or trowel-shaped, very obtuse at apex and truncate at base, green, sometimes dark-pink below, margin (and veins) coloured pinkish-brown, slightly sinuate-crenulate, generally with one notch on each side near apex (sometimes two), and (together with bracts, calyx, and corolla) having many scattered pellucid

dots, and a few straggling white hairs on veins below. Flowers white, axillary, mostly in pairs, sometimes ternary and fasciculate, and occasionally single; peduncles short, stout, and (with pedicels) pubescent; pedicels slender, 2–2½ lines long, each with a pair of foliaceous ovate bracts on long petioles; calyx tubular-campanulate, 1½ lines long, villous and ciliate, with spreading white hairs, largely and strongly ribbed, about 15 ribs; ribs and margins of lobes coloured reddish-brown; lobes large, triangular, acuminate, villous on inside; corolla lobes large, flat, spreading, elliptic, very obtuse, slightly crenulate and waved, upper one bifid; stamens exserted, anthers lilac; style largely 2-lobed; stigmas much recurved.

Hab. Dry grassy spots, margins of woods near Norsewood, County of Waipawa; 1882–85: *W.C.*

Obs. I have known this little plant for some time, every summer observing it on visiting its habitat, and had supposed it to be identical with *M. cunninghamii*, Benth., yet not without doubts. However, on closely examining it this year (January, 1885), I have detected several characters (*vide descript. supra*) that are not in accordance with those of the N. species (*M. cunninghamii*), as severally described by Cunningham, Bentham, and Hook. fil. It is also much smaller in all its parts, except the flowers, which are larger.

ORDER LXVII. THYMELEÆ.

Genus 1. **Pimelea**, Banks and Sol.

1. *P. angulata*, sp. nov.

Branches stout, bark glabrous, brownish-red, studded with raised scars from fallen leaves. Leaves (and branchlets) glabrous, rather crowded, decussate, broadly lanceolate, sub-acuminate, about 1 inch long (a few shorter), 2–2½ lines broad, spreading and deflexed from base, flat but slightly concave towards tip, sub-coriaceous, green above, sub-glaucous and veined below, midrib not prominent, petiolate; petioles 1 line long, white, broad, and adpressed to stem; floral leaves 3–4, much like the cauline but narrower. Flowers terminal on short young branchlets 1–2 inches long, closely compacted in heads of 10–25 flowers, white, erect at first but spreading in opening, villous without, shortly peduncled, peduncles rather stout and very hairy; tube infundibuliform, ½ inch long, quadrangular and channelled, constricted below the middle and again swelling at the base, yellowish above and pink below constriction, hairs very long at base; lobes of perianth patent, 2–2½ lines long, broadly elliptic, sub-acute, sub-convex or raised longitudinally in the middle, with margins slightly incurved, tips resolute and ciliate; stamens largely exserted, divergent; anthers oblong, obtuse, dark orange; style length of tube, sometimes exserted, finely

corrugated at base; stigma sub-penicillate; ovary oblong, glabrous, hairy at tip around base of style; hairs long, white.

Hab. Open hilly country in the interior, at Patea, between Napier and Tongariro; kindly sent me by Mr. A. Lascelles.

Obs. I have had but one small branch of this plant, containing, however, 10 heads of flowers. It seems to be a short, much branched shrub, presenting a *Daphne*-like appearance, and would make a pretty garden plant; flowers inodorous. A few perianths possess 3, and even 4, fertile anthers, while many have 2 abortive filaments (some only 1) in addition to the anther-bearing ones, of the same length, and opposite to the other 2 lobes of the perianth. As a species it is very distinct from the known New Zealand ones, (and more so from those of Australia,) but it approaches *P. longifolia*, Banks and Sol., and *P. gnidia*, Forst.

Order LXXI. URTICEÆ.

Genus 4. **Australina**, Gaudichaud.

1. *A. hispidula*, sp. nov.

Plant small; every part, including flowers, being more or less hispid; stems 3–4 inches long, stoutish, implexed, finely and closely retrorse-pubescent, procumbent, creeping, rooting at nodes; branches numerous, short, ascending, ¾ – 1 inch long. Leaves small, sub-reniform and sub-orbicular, always broader than long, truncate at base, 1–2 lines long, 1½ – 2½ lines broad, largely and regularly 5-crenate, hispid and rough with raised points and short white hairs, dark green above, pale below, veins very stout below, and with margins red; petioles rather long, slender, reddish; stipules 2 lines long, subulate, hairy, recurved. *Male* flower single, or 2–3 together, in upper axils on one long succulent peduncle, twice the length of petiole; perianth sessile, diverging, sub-boat-shaped, divided at middle into two concave lobes, the outer one the largest, membranaceous, bladdery, light-green splashed with red, margins irregularly crenulate, dark-green; stamen large, stout, glabrous, transversely ribbed on the back, much recurved; anther large, petaloid, pure white splashed with red on the outside. *Female* flower in lower axils, in pairs but separate, sub-sessile with two small coloured bracteoles; perianth ovate, sub-compressed, semitransparent, light-green with a narrow dark-red margin, mouth somewhat 3-fid, tips laciniate; style and stigma excluded, as long as perianth, obtuse, recurved, brown, very shaggy, hairs flat and branched.

Hab. Sides of streams in shaded spots near Norsewood, County of Waipawa; 1883–85: *W.C.* Also eastern bases of Ruahine mountain range, same county; November, 1885: *Mr. A. Hamilton.*

Obs. A species very nearly allied to *A. pusilla*, Gaud. (which also grows plentifully in or near the same localities), but is very much smaller, and differs from that species in several particulars (*vide descript.*). I have occasionally found two perfect stamens issuing from one male perianth; and in a very few specimens, the female perianth in the upper axils above the male; and, in one instance, both male and female singly in one upper axil.

Class II. MONOCOTYLEDONS.

ORDER I. ORCHIDEÆ.

Genus 1. **Earina**, Lindley.

1. *E. alba*, sp. nov.

Stems stout, 8–10 inches long, sometimes branched at or near base. Leaves alternate, sessile, sub-linear-acuminate, acute, broadest near base, thickish, rather harsh and sub-rigid; petioles long, clasping, decurrent, extending to within the petiole below, black margined. Flowers terminal in compound panicles, 2–4 inches long, rather close-set, sub-distichous, each sub-panicle usually containing three flowers; bracts numerous, imbricated, striate, brown, the lower acuminate and fimbriate, the upper obtuse with a small mucro. Perianth pure white, 5–6 lines diameter, segments of equal length, spreading, recurved, obscurely 3-nerved, very obtuse; sepals ovate-oblong, margins entire; petals broadly obovate, crenulately notched on the middle of the upper margin; tip broadly oblong (or sub-5-sided), entire, obtuse or slightly retuse at apex, margins corrugated and incurved, two small ochraceous-yellow spots near the centre of tip, and two small greenish crescent-shaped calli beyond those spots and near the base. Column sub-hooded, tip ochraceous-yellow (exactly same hue as the two spots); appendages overhanging in front below anther, and produced in 4 small obtuse teeth and a minute tubercular wing on each side, with 2 minute mammillary-like dots in front, immediately below stigma. Ovary long, cylindrical, striate, twisted.

Hab. On edges of rocky cliffs and on dry stony declivities, and about the dry exposed roots of *Fagus solandri*; banks of River Mangatawhainui, Seventy-mile Bush, County of Waipawa; 1878–85: *W.C.*

Obs. This plant in appearance closely resembles *E. autumnalis*, Hook. fil., of which it may (by some botanists) be considered as a variety. It possesses, however, sundry characters which that species has not, or which, at all events, are not given in any published description of it that I have seen. Indeed, Hook. fil., says of the genus, "disk eglandular;" whereas the disk of this species possesses two crescent-shaped greenish calli. *E. autumnalis*, which is so very common in the woods at the N., is a larger and fresher-looking plant, with flowers "speckled and sweet-scented," and is always epiphytical. Can difference

of situation bring about change in characters as well as in habit? This plant is very plentiful in the locality named, causing those dry woods and stony cliffs to look lovely in the autumn season. It has given me a deal of repeated trouble and research, extending over several years, as for a long time I only took it to be a variety of *E. autumnalis*.

Genus 5. **Gastrodia**, Br.

1. *G. leucopetala*, sp. nov.

Root a long sub-cylindrical greyish-flesh-coloured pubescent tuber, encircled throughout with several rows or rings of scarious long light-brown ovate-acuminate scales, the rows being pretty regular and close together, of about 5 rows to 1 inch, somewhat resembling the sheaths on the stem of some species of *Equisetum*. Stem 2 ft.–2 ft. 9 in. high, erect, sub-succulent, stout, 8 lines diameter and cylindrical below, sub-angular at top, smooth, light-brown with short purplish stripes; 8–9 bracts, perfoliate, membranaceous, distant, on lower part of stem, margins entire, dark purplish-brown, spotted with light-coloured spots much like perianth. Flowers 20–40 at top of stem in a raceme 10–15 inches long, pendulous, rather distant, scattered, pedicelled; pedicels 2½ – 4 lines long, each with a single sessile bracteole at base 2–2½ lines long, 1 line broad, ovate-acuminate, sub-scarious, reflexed, coloured like those of lower stem but darker. Perianth thickish, papillose, dark brownish-green spotted with large light- (sub-fawn-) coloured spots without, whitish within, ventricose at base, anterior portion much curved upwards, 6–7 lines long excluding ovary, mouth open, 4½ lines diameter, quinquefid; segments spreading, veined, veins branching at tips, margins crenulate; two lateral sepals largest, deltoid, sub-acute and recurved; upper sepal oblong, obtuse and emarginate; two lateral petals pure white, adnate, projecting from just within perianth tube, linear-oblong, concave, tips truncate and retuse, margins thickened, slightly crenulate, and recurved; labellum white, 3-nerved, disc contracted below the middle, the anterior portion sub-rhomboidal with two reddish longitudinal ridges, their margins thickly crenulato-fimbriate, rising divergent from the middle and united towards tip, but not joined to it; tip produced, thickened, recurved, verrucose and dark-brown at apex; anterior margins of disc finely crenulate-waved and incurved, the middle margins plain and spreading, posterior margins thickened, largely raised, waved and incurved; claw plain and grooved; ovary thick, ovoid, coloured as perianth, at first 3–4 lines long, after flowering twice that size.

Hab. In dark forests on the eastern slopes of the Ruahine mountain range, 1850–52; and in similar spots in the Seventy-mile Bush, between Norsewood and Danneverke, County of Waipawa, 1884–85: *W.C.*

Obs. I. I have long known this plant, (for upwards of thirty years,) but have never obtained good flowering specimens until this summer (January, 1885). I had, however, always suspected it to be a distinct species from the known endemic one (*G. Cunninghamii*, Hook. fil.), although the specimens I had detected in the woods in autumn travelling were always long past flowering. Having again met with it in those woods near Norsewood in April, 1884—but, as before, too late!—I marked those spots, and in visiting them again in January, 1885, (almost purposely,) I was rewarded with finding a *few* in flower on the top of two racemes, not, however, so many as I could wish, and in localities some miles apart. It now appears that the lowermost perianths on their long raceme expand first, and so regularly proceed up the stalk, like many other flowers produced in racemes and spikes. Having obtained, after all, only a very small number of really good flowers, (though plenty of both unopened and withered ones,) and being very desirous of sending them preserved in spirits to Kew, I have only dissected *one* perfect flower. Of this I have given a very minute description, in the hope of its being compared by some one of our working botanists with *G. cunninghamii*, which, I fear, is daily becoming more scarce.

Obs. II. I believe this plant to be very distinct from the other long-known New Zealand species, but, unfortunately, I have no specimens of that species left for comparison, and the description of it in our botanical books is neither complete nor minute. The pure white petals of this species are a most striking object when fresh and in its dark habitat; its lip, too, is widely different from that of *G. cunninghamii* (viz., the description of it given in our books of the New Zealand Flora); indeed, its lip is more like that of the Australian species, *G. sesamoides*, Br., though the perianth differs considerably. Of this species a fine drawing, with dissections and description, is given in the "Flora Tasmaniæ" (Bot. Antarctic Voyage, vol. vi.).

Genus 10. **Microtis**, Banks and Sol.

1. *M. papillosa*, sp. nov.

Plant rather stout, 1 foot – 1 foot 6 inches high, finely and thickly papillose. Leaf erect, fistulous, ribbed internally, much longer than scape. Spike 1½ – 2 inches, flowers not crowded, sub 30; pedicelled; pedicel short, about 1 line long, stoutish; bracts oblong, acuminate, acute, 1-nerved, longer than pedicel, adpressed to flower. Perianth, upper sepal orbicular, 3-nerved, concave, apiculate; lower pair, ovate, acute, recurved; lateral petals linear-ovate, very obtuse; labellum oblong, waved and crisped, sub-fimbriate, bifid, sinus broad, truncate at base, apical lump at base of sinus, large, verrucose, continuous to the

two lumps at base of labellum, which are again divided, so making four.

Hab. Kaipara Heads, West Coast, North Island; *Mr. C. P. Winkelmann*; in letter, October, 1884. Flowering in October.

Genus 12. **Pterostylis**, Br.

1. *P. patens*, sp. nov.

Stem stout, 1-flowered, 4 inches high; 2–3 short ovate acute brownish and scarious bracts near base; 4–5 stem-leaves, equidistant, 3 inches long, 5–7 lines broad, sub-linear-lanceolate, not narrowed at base, sub-acute, recurved and revolute, thickish, finely papillose, keeled, 3-nerved, nerves obscure; uppermost leaf shorter, close to base of ovary, 1½ inches long, erect, half the length of perianth and sub-clasping. Perianth large, very open, bladdery, particularly at base, which is sub-globular, somewhat sub-quadrate in outline and very wide; upper parts of segments brownish-red, extending low down on lateral sepals. Galea erect, broadly arching and flat above, 2 inches long without tip; tip of dorsal sepal hooked, sub-acuminate, extending ½ inch beyond lateral petals, which are strongly 1-nerved, broad at tips, and acute; lower lip, the entire part thrown largely forward and downward, cuneate, ¾ inch long, much concave between lobes, their margins incurved above, and the lobes suddenly and completely reflexed below base of perianth, and extending downwards and horizontally beyond base of upper bract (or floral leaf), tapering into stoutish points more than 1 inch long. Labellum prominent, very irritable, linear-oblong, 10 lines long, 2½ lines wide, truncate at base, recurved at tip, with a longitudinal central stout ridge throughout; tip thick, obtuse, red, minutely papillose; claw stout, curved, nearly 2 lines long, a thick green protuberance on under surface opposite to its base, and a large tuft of stoutish spreading fimbriæ at tip, which are also lobulate or branched; column slender, wings incurved, large, more than 4 lines long, front margins sub-sinuate with a long finely subulate erect tooth from upper front angle rising above anther, lower lobes obovate or oblong and rounded, margins entire; stigma long, narrow, not prominent, at its central base an erect subulate white appendage, 2 lines long, projects forward from between two finely incurved corrugated lines or side-angles of lower column.

Hab. Forests, hilly country, near Norsewood, County of Waipawa; 1883–84: *W.C.* Glenross, County of Hawke's Bay; 1884: *Mr. D. P. Balfour.*

Obs. I. I first detected this plant in 1883, but then, while perfect, it was past flowering. Believing it to be a new species, I brought away carefully its tubers and planted them in a pot, and they have grown strongly and flowered. I have had, however, but one fresh flower to examine, but this was so large,

fully developed and gaping, that I had no difficulty in so doing, and that without breaking-up or even gathering the specimen.* Its form is striking, and its habit peculiar; all its floral parts being so very open and free, and its lateral sepals wholly deflexed horizontally; in these characters I have not seen anything like it among all the flowers of the genus, neither in these species of New Zealand, nor in those of Australia and Tasmania.

Obs. II. I may also remark that a slenderer plant of the same height grows close to the above, (in the pot,) as if from a twin-tuber, the three leaves of this are near the top of its stem, and are about as long as those of the other, but are sub-linear-spathulate; it has also a similar scarious bract at the base. It may be the barren or leafing form (young) of this species; as such obtains among some of the Australian and Tasmanian species—as, for instance, in *Pt. obtusa,* Br., Hook. fil., "Flora Tasmaniæ," pl. 115, C.

2. *P. rubella*, sp. nov.

Small, erect, slender, glabrous, 3–4 inches high. Leaves 2–3 at base, cordate, 3 lines long, petioles same length; cauline bracts 4, ovate-lanceolate, the lowest petiolate, the upper 3 sessile, half-clasping. Flower solitary, erect, 6–7 lines long; dorsal sepal arched, convex, striate, very acuminate, 9 lines long; lateral sepals (lower lip) connate, emarginate, with two long slender green tails, erect and spreading, 10 lines long, rising much above galea; petals, lanceolate-acuminate, acute, of same length as dorsal sepal; lip glabrous, dark-red, linear-lanceolate, acuminate, 4 lines long, under 1 line wide, grooved, tip thickened, obtuse; appendage curved, red, trifid-laciniate and minutely fimbriate or sub-penicillate, not villous; column, wings red, rounded above, not horned, largely produced and slightly fimbriate below.

Hab. Whangaroa, County of Mangonui; 1884: *Mr. R. W. Rowson.*

Obs. A species having some affinity with *P. trullifolia,* Hook. fil.

3. *P. tristis*, sp. nov.

Plant very small, rather dingy-looking, with a greyish-green appearance. Leaves small, 5–7 sub-rosulate, broadly ovate, obtuse or sub-acute, thickish, pale-green, deeply pitted, sub-concave, midrib stout, white and prominent below, margins closely and finely sub-crenulate, about $\frac{1}{2}$ inch long, including petiole; petiole very broad and stout, 2–3 lines long, white, with three green veins. Scape stoutish, 2–2$\frac{1}{2}$ inches high, with

* I have, however, since writing the above, received flowers of several plants from Mr. Balfour, which fully agree with my description. (November, 1885.)

3–4 long acuminate bracts, clasping, adpressed, besides those under each pedicel. Flowers 2–3, on rather long pedicels, light-brownish striped with red, scarcely ¼ inch long, and nearly as broad, sub-second, slightly drooping, gaping; galea boat-shaped, much and somewhat abruptly arched with a short tip; petals broadly lanceolate or sub-rhomboidal, lower margin cilio-serrulate, tip acute; lower lip sub-orbicular, bifid nearly to middle, tips sub-acute, scarcely produced; labellum small, pale, highly irritable, broadly oblong, margin entire, very obtuse, with two minute crenulations at tip; appendage short, thickened and rounded at base, sub-erect, free, dark-green; column wings sub-quadrate, auricled, auricles very obtuse and rounded, their margins finely ciliate, not produced above, but front upper angle thickened and dark-green; the lower and slender portion of the column broadest in the middle; stigma small, scarcely prominent. Ovary (immature) long, clavate; valves widely separate, with narrow, raised, green margins and round apices.

Hab. Open turfy spots, flat lands, south bank of the river Waipawa; 1885: *Mr. H. Hill.*

Obs. I. This is an interesting little species, from its differing so very widely from all its known New Zealand congeners: yet, in several particulars, allied to some of the small Australian species, as *P. mutica*, Br., and *P. aphylla*, Lindl. Its little labellum is very irritable, (like those of some other species of this genus,) closing sharply up against the column with a spring on being only slightly breathed on! and so remaining. Their root-leaves, like those of the allied Australian species above-noted, mostly wither before flowering.

II. In the spring of this year (1885), I received from Mr. Hill two very small plants about ¼ inch high, with their tips of greyish leaves scarcely emerging above the tuft of mosses among which they grew, yet, fortunately, with their subterranean stems and little tubers complete. These I carefully planted, and was rewarded in seeing them flower in November. Mr. Hill informs me that it was on a spot where he was resting, during his journey, that he casually found them (in the mosses). I presume, from the smallness of the plant, and its dull, uninviting appearance, it has long been overlooked.

Genus 15. **Thelymitra**, Forst.

1. *T. alba*, sp. nov.

Rather stout, 8–9 inches high. Leaf linear, 10–11 inches long, 3–4 lines broad, rather thin, many-nerved (sub 10), nerves closely and finely papillose at back in lower part of leaf. Raceme 3 inches long, 8-flowered; pedicels ½ inch; bracts large, 1–1½ inches long, oblong, suddenly acuminate, very acute, 10-nerved (as also sepals and petals). Sepals light-greenish purple with very thin white margins; petals pure white; both with

labellum broadly ovate-acuminate with a mucro at apex, and all of equal size. Column rather short; tip recurved, deeply notched, sides of hood produced, with 2 angles, and notched in front between them; dark-brown with yellow margin; the appendages much produced in front, as high or higher than the column, very plumose; hairs white, branched, closely barred and knobbed at tips; side wings of column much excised; stigma large, sub-quadrate, sinuate and slightly laciniate at base; 2 small erect teeth in front, in centre of column margin; rostellum globular, prominent; anther tip long, subulate, obtuse.

Hab. Glenross, County of Hawke's Bay; 1885: Mr. *D. P. Balfour.*

Obs. A species having pretty close affinity with *T. longifolia,* Forst.; *T. nuda,* Brown; and *T. nemorosa,* Col.; but differing from them all in several characters.

Genus 17. **Prasophyllum,** Br.

1. *P. pauciflorum,* sp. nov.

Slender, erect; stem 7 inches high. Leaf-sheath 3 inches longer than spike, narrow, tip thickened, acute, blackish. Spike short, few-flowered (7); flowers distant, pedicelled, pedicels very short; bracts small, truncate with sinuous margin, or notched. Perianth rather small, sub ¼ inch, spreading, light yellowish-green; dorsal sepal broadly ovate, acute; lateral sepals united from middle downwards, acute slightly acuminate, entire not notched; petals linear, obtuse, 3-nerved, the lateral nerves only reaching half-way; lip small, broadly orbicular-ovate; lamina thin, 3-veined, the 2 outer veins branched, margin entire but slightly sinuate; claw very short; tip recurved with a small yellow globular lump adnate at the bend; column very short and thickish, with a broad membranous rounded hood at back above anther, margin of hood entire, and 4 minute erect linear lateral staminodia; ovary short, turgid.

Hab. Hills, country west of Napier; 1883: *W.C.*

Obs. I have obtained only one specimen of this plant; and, though early satisfied of its being very distinct from the three published New Zealand species, and also from all the Australian and Tasmanian ones described by Bentham in "Flora Australiensis," I wished to get more specimens before describing it, as there may be some variation in size and number of flowers; not, however, being successful, I now make it known.

Genus 18. **Orthoceras,** Brown.

1. *O. rubrum,* sp. nov.

Root, a small fusiform white tuber. Stem rigid, erect, slender, smooth, 1 foot high, greenish dashed with purple-red,

Leaves few; basal 2–3, green, erect, thickish, linear, very narrow, 5–6 inches long, less than 1 line wide, deeply channelled, margins conniving, very acuminate, tips piliferous; cauline 2, nearly equidistant, similar to basal but smaller, adpressed to stem, with large red-coloured membranaceous sheathing bracts at base, acuminate. Flowers 3–5, small, dark-red, thickish, rather distant, pedicelled in a short raceme at top of stem, the bract at base of pedicel broad, sheathing, membranaceous, ovate-acuminate, acute, 9–10 lines long, 3 lines broad, many nerved, not keeled. Dorsal sepal very broad, sub-quinquangulato-orbicular in outline, 5 lines long, 3½ lines broad, apex slightly obtusely-angled with a fine mucro, sub-10-nerved, margins thin, entire, incurved; lateral sepals very narrow, almost wiry, erect and curved, 8–9 lines long, deeply channelled, tips acute; petals thin, white, narrow-linear above, broad and spreading below, bifid at apex. Labellum heart-shaped, 4 lines long, 3 lines broad, slightly and finely transversely wrinkled, side margins incurved, tip acute; lateral lobes sub-ovate, obtuse, the middle lobe slightly larger, broadly-ovate-acuminate; the transverse callus at the base of the lateral lobes smooth, triangular, bifid at apex, and recurved towards column. Column, tip apiculate, sides conniving, the two lateral appendages finely subulate, rough.

Hab. Open grounds among fern, high clayey hills between Napier and Mohaka, Hawke's Bay; 1870–76: *W.C.* Glenross; 1885: *Mr. D. P. Balfour* (a single specimen only).

Obs. This plant has been long known to me; and, while I had my doubts as to its being identical with the northern form of this genus (*O. solandri*), mainly from the difference in colour, in its being more slender, and its general appearance, I never satisfied myself till this year; partly owing to my want of spcimens of the northern plant for comparison, as well as to my not possessing any full description of it, neither of the Australian species (*O. strictum*); for R. Brown, Lindley, A. Cunningham, and Sir J. D. Hooker, say very little about the two species. More recently, however, Bentham, in his "Flora Australiensis," has gone fully into the Australian plant; and as now I have also A. Richard's full description of the New Zealand one, with a folio plate of drawings and dissections, I have closely examined and compared this species, and I find it to be (as I had supposed) different, and that in several characters. Bentham, however, states that the two long known plants of Australia and New Zealand are but *one* species. His words are: "The New Zealand plant does not appear to me to differ in the slightest particular" (*loc. cit.*). This may be the case with the old and early described New Zealand one; which, from description, drawing, and dissections by A. Richard, is very distinct from this species.

ORDER VII. LILIACEÆ

Genus 6. **Arthropodium**, Br.

1. *A. reflexum*, sp. nov.

Plant small, leaves many, 10–12, nearly flat, grass-like, membranaceous, green, glabrous, margins purple, sub-linear-lanceolate, acuminate, tips acute, 9 inches long, 3 lines wide, spreading, drooping, obsoletely veined, keeled below, half-clasping and deeply canaliculate at base, with margins conniving, bases (also those of pedicels and scape) thickly purple-spotted; scape 9–10 (or more) inches long, erect, sub-flexuous, very slender, almost filiform, less than ½ line diameter at base; cauline or floral leaves large, foliaceous, spreading, cernuous, sub-linear, acuminate, broadest near base, sessile, half-clasping, lowest 4½ inches long, 2 lines wide, upper 1 inch long and 1 line wide. Flowers distant, lowest internode 1¾ inches, alternate, somewhat sub-verticillate, axillary, (two together in lowest leafy bract only, but separate,) with a small, coloured, broad, and truncate membranaceous bracteole between pedicel and scape; raceme 6 inches long, 9–11 flowered; pedicels ¾ inch long, slender, drooping, jointed above the middle, lowest longest; perianth white, wholly and strictly reflexed and nodding (like *Cyclamen*); segments 6, sub-convex, 2½–3 lines long, green at bases; three outer, oblong-ovate, obtuse and thickened at tips, 3-nerved; three inner oblong, rumpled, sub-fimbriate above, emarginate; filaments white, much shorter than perianth, 1¾–2 lines long, slender, naked, more than ⅓rd length from base, densely hairy above, but not close up to anther, hairs very short at top, being gradually reduced in size upwards, large and bushy at middle, patent, moniliform, largely clavate and compound-branched; anthers pale, small, about ⅓rd line long, oblong, broadest at base, but not divergent, recurved at tips; style glabrous, erect, much longer than anthers, 2 lines long; stigma spreading, finely penicillate; ovarium green, glabrous, sub-oblong-globose, flattened at tips. Capsule (ripe) bluntly deltoid, 2 lines diameter, depressed, very membranous, green, much rugose from seeds; seeds many (15), broadly-oblong, turgid, slightly and irregularly sub-compressed, black, shining, very minutely dotted; funicle long, slender, adhering.

Hab. Shaded sides of mountain streams, Seventy-mile Bush, County of Waipawa; 1870–83: *W.C.*

Obs. I. This graceful little species is nearly allied to our other small New Zealand species, *A. candidum*, Raoul, and also to *A. neo-caledonicum*, Baker,* differing, however, in several characters. I have long known this plant, and always suspected

* See "Journal Linnean Society," vol. xv., p. 352.

it to be distinct from *A. candidum;* but not till this summer (January, 1885) did I obtain it in its flowering state, and then only by bringing its roots away last year from the woods and planting them in a flowering pot: they have grown well and rapidly.

Obs. II. This plant has some peculiar habits, which, having repeatedly noticed them, are worth recording. It only opens one flower at a time, beginning at the lowest, when the segments of its perianth quickly assume their tightly reflexed position, and its anthers are already bursting at their tips; it only remains open for one day, closing at nightfall, when the segments, etc., are closely and longitudinally appressed to the ovary, where they remain. The ovary rapidly swells, and its pedicel elongates. After the first lowest flower has flowered, the second one in the same axil (scarcely visible before) begins to lengthen its pedicel, but this did not expand. Its leaves begin early to wither at their tips, before the plant has opened one-third of its flowers.

Order IX. JUNCEÆ.

Genus 8. **Luzula,** De Candolle.

1. *L. sub-clavata,* sp. nov.

A tufted erect herb, branching from the roots. Culms slender, sparingly leafy, 18–24 inches high. Leaves numerous, flat, and grass-like, 5–6 inches long, 2 lines wide, 16-nerved, with distant transverse nettings, apices thickened terete and sub-clavate, margins slightly and distantly serrulate, and sparsely ciliate with very long whitish hairs. Flowers in a long, loose, slender panicle of 2 (sometimes 3) sub-sessile broadly ovoid many-flowered heads, several inches apart; heads ½ inch diameter, simple or compound, on short pedicels, the lowermost head having 2–3 long narrow foliaceous bracts at base, their apices thickened and terete like those of the leaves, the uppermost head is usually bractless. Perianth small, 1 line long; segments ovate-acuminate, whitish-brown with a dark central line, much longer than capsule; stigmas long, flexuous, and rough. Capsule sub-ovoid, triquetrous, smooth, shining; valves broadly oblong-lanceolate, apiculate, with a strong central vein. Seeds oblong, turgid, darkish brown, shining, finely reticulate-striate, with a dark spot at tip, the hilum produced and puberulous, and a narrow white line forming the ventral suture. Bracteoles small, broadly ovate, white, shining, adpressed; tips minutely ragged with a mucro.

Hab. Dry woods, banks of River Mangatawhaiiti, between Norsewood and Danneverke, County of Waipawa; 1885: *W.C.*

Order XI. CYPERACEÆ.

Genus 4. **Scirpus**, Linn.

1. *S. novæ-zealandiæ*, sp. nov.

Rhizome creeping, branched, woody; stems simple, and branched at base. Culm slender, 2 feet high, 1 line wide, trigonous, cylindrical at base, solid, smooth, pale sea-green. Leaves 3–4, much shorter, longest about half the length of culm, distant, linear, sub-grass-like, 1½ lines wide, smooth and same colour as culm, deeply channelled, sheathing, apices blunt, margins of tips scaberulous; sheaths long; ligula large, elliptic, membranous; sheathing bracts at base 3–5, broad, 3 lines wide, transversely netted, uppermost abruptly contracted at apex and cuspidate; cusp narrow linear, nearly 1 inch long. Spikelet solitary, lateral, broadly ovoid, 3–4 lines long, 1½ lines broad, sessile, dark red-brown, 12–15-flowered. Glumes broadly ovate, very concave, densely imbricate, membranaceous, very thin at margins, erose and sub-fimbriate towards apex, bifid, aristate, much keeled, red, glabrous, shining; outermost obsoletely 3-nerved, very broad and clasping, transversely wrinkled, finely fimbriate, largely and coarsely aristate. Involucral bract 1½ – 2¼ inches long, erect, continuing the culm and precisely like it, slightly hollowed into a sheath at the base, with short broken and scarious margins; tip flattened, sub-acute, margins scaberulous like leaves. Style long, blackish-brown; stigmatic branches 3, longer than style, flattened at bases, roughish, obtuse. Anthers linear-acuminate, with a long acuminate connective, truncate at base, light-yellow; filaments flat, 1-nerved, pale-coloured. Hypogynous bristles 3–4, shorter than nut, linear, obtuse, largely retrorse-scabrid, red-brown. Nut broadly obovoid, $\frac{1}{10}$th of an inch long, tipped with a small black point remains of style, gibbous, flat on one side, smooth, shining, pale drab-brown minutely spotted with red; clustered and sessile in little niches around short thick sub-tetragonal spike, upper 3-4, small, abortive.

Hab. Sandy flats, low margins of rivers, Hawke's Bay; *W.C.* Near Puketapu; 1885: *Mr. D. P. Balfour.*

Obs. A species having affinity with another indigenous species, *S. triqueter* (of R. Brown), and of "Flora Novæ Zelandiæ," and also of the "Handbook New Zealand Flora," but said by Bentham not to be the *S. triqueter* of Linn., but to be *S. pungens*, Vahl, ("Flora Australiensis,") differing, however, in several characters.

Genus 6. **Isolepis**, Brown.

1. *I. reticularis*, sp. nov.

Plant small, gregarious, loosely tufted, filiform, flaccid, sub-erect and drooping, light-green. Culms 5–8 inches long, sub-cylindrical, compressed, channelled on inner surface. Leaves

many, shorter than culm, each one (also culm) issuing from a fistular sheath; sheaths $\frac{1}{2}$ – 1 inch long, red, sulcated, glossy, truncated with a rather long, abrupt linear mucro. Involucral bract usually 1, erect, obtuse, continuation of culm, $\frac{1}{4}$ – $\frac{1}{2}$ inch long. Spikelets ovoid-acuminate, generally 3, lateral, 1–2 lines long, the middle one longest, pale coloured with conspicuous green stripes, sometimes only 1, and also (but rarely) 4–7 and then proliferous, with small leafy bracts arising from coloured sheaths. Glumes numerous, about 15, concave, broadly ovate, sub-acute, whitish, sprinkled with oblong red dots, and a broad green line on the back, but not keeled, strongly and many-nerved, netted with numerous transverse veinlets, margins entire, thin. Nut very small, elliptic, slightly sub-trigonous with a narrow produced margin and a long apiculate beak, shortly pedicellate, pale whitish-brown, smooth, glossy. Style red-brown; stigmatic branches 3, long, curved, scarcely scaberulous but roughish, as with minute tubercles. Stamen 1, filament clavate, often persistent on nut and nearly twice its length.

Hab. Low wet grounds, sides of rivers, and damp shaded woods, where it forms large grass-like beds; Seventy-mile Bush, County of Waipawa; 1880–85: *W.C.*

Obs. A species having pretty close affinity with *I. inundata*, *I. riparia*, and *I. prolifera*, Brown, (*Scirpus* of Sprengel, and of Bentham, "Fl. Australiensis,") but approaching nearest to the former; differing, however, in its many leaves, and in its nut being narrower and obtusely angled, with a long terminal point; and from them all in its peculiar netted scales, and in its coloured truncated sheaths to leaves and culm.

Genus 10. **Gahnia**, Forst.

1. *G. scaberula*, sp. nov.

Plant bushy, in moderate size tufts, leaves rough, 3–4 feet long, spreading; culms terete, smooth, leafy, about same length as leaves. Panicle 18 inches long, compound, slender, nodding, general colour light-brown; sub-panicles and pedicels light yellowish-green; peduncles and sub-peduncles slender, roughish, compressed; pedicels scabrid, flattish, rigid, 2–4 lines long; floral bract scaberulous, 7-nerved, very acuminate, sub-awned, dark red-brown, edges scarious and pale-coloured. Spikelets small, slender, 3 lines long, with generally seven glumes closely appressed; the three outer glumes minutely rough above, dark red-brown, the outermost one 3-nerved, scabrid on central nerve, aristate, barbed; the inner glumes 1-nerved, acuminate, very small and convolute, with very concave margins and obtuse apiculate tips, smooth below, scabrid at tips, the innermost one wholly puberulent and emarginate, their bases white, tips reddish-purple. Stamens: anthers 4, linear-lanceolate, $1\frac{1}{2}$ lines long, pale straw-colour, with a long acuminate and serrulate

connective, rather abrupt at base; filaments a little shorter than anthers. Style long, scabrid, especially at base, 2-branched, each branch with two very long flexuous stigmata, sometimes with an odd one, five in all. Nut transversely grooved within, sub-spindle shape, 3 lines long, obtusely ribbed, shining, red, apex black and scaberulous, slightly produced and crowned with the persistent base of style, when fully mature pendulous in long hypogynous scales (or "filaments" of authors), which are 4–8, bright-red, long and very narrow, much crumpled and twisted.

Hab. Dry spots, margins of forests, Seventy-mile Bush, County of Waipawa; 1880-85: *W.C.*

Obs. I have known this plant for several years, but it was only during this summer (1885,) that I obtained perfect and complete specimens; this, however, was partly owing to my not greatly caring to gather it for examination, believing it, from its general appearance, to be one of the already-described species.

[See my note on this genus at the end of my descriptions of these *sp. nov.*]

2. *G. parviflora*, sp. nov.

Plant forming small diffuse bushy tufts. Leaves very narrow, almost linear, 3 lines wide, 3 ft. 6 in. long, with long filiform tips, margins thickened and recurved, upper part of leaf scabrid, the lower smooth. Culms 2 ft. 6 in. to 2 ft. 9 in. long, very leafy, cylindrical, smooth; panicle 18–20 inches, slender, open; sub-panicles (6–7) 3–4 inches apart; spikelets distant, not crowded. Floral bract broadly ovate, corrugated, aristate, arista short; sub-panicle, stem sub-4-angled below, angles rough, 3-angled above, compressed, scabrid. Spikelet broadly obovate, sub 3 lines long, blackish; glumes all large and broad and nearly of equal size, oblong-ovate, acute, not acuminate, loosely concave, smooth, pubescent or roughish at tips, the outer glumes largely corrugated, the outermost much shorter than spikelet. Style long, black, thick at base, with short red hairs; stigmas 4, sub-fasciculate, long and branching from below close to the forking of the style. Nut narrow ovoid, somewhat turgid, 2½ lines long, slightly grooved, whitish, tip brownish, red and shining when mature and old, transversely rugulose within, base of style persistent. ? Hypogynous scales ("filaments" of authors), 8, very long and fine, much crumpled and entangled, dark-red.

Hab. Scattered among low bushes and small scrubs, dry hills, near the bridge over the River Whakaruatapu, Seventy-mile Bush, County of Waipawa; 1881: *W.C.*

3. *G. exigua*, sp. nov.

Plant rather small, slender, spreading, forming small separate tufts. Leaves narrow, about 2 feet 6 inches long, striate

below, scabrid, margined, excessively long filiform at tips. Culms 3 feet long, slender, leafy; stem-leaves very long, drooping, narrow and filiform at tips. Panicle very slender, 2 feet to 2 feet 6 inches long; sub-panicles distant. Floral bract narrow, excessively acuminate, 13–14 lines long, (of which the filiform beak is more than half,) slightly roughish, light-brown. Spikelet very slender, 2½ lines long, narrow, obovate-lanceolate, with sharp tips of outer glumes extending beyond, dark-brown; pedicels filiform, scabrid, rigid, 2–4 lines long; 4 outer glumes very acuminate and decreasing gradually in size, 1-nerved, minutely scabrid on nerve at back and on margins (especially the two outer), red-brown; 3 inner small, obtuse, apiculate, smooth, white below, reddish and finely scaberulous at tips. Stamens: anthers 4, subulate; connective long, acuminate, acute, entire, minutely and distantly roughish under a lens, base sub-sagittate; filaments shorter than anthers. ? Hypogynous scales ("filaments" of authors) 6–8, very long, fine, crumpled and twisted, reddish-brown, filiform below, broader, flat, 1-nerved, and obtuse at tips. Style rather long, slightly rough, thicker and pubescent at base, pale red-brown. Stigmas 3 (rarely 4), long, sub-fasciculate, roughish, dark-brown. Nut (immature) minutely puberulous at tip; ripe, 2½ lines long, broadly lanceolate, shining, grooved, and obtusely angled, red with a black spot at tip, base of style persistent, transversely grooved within.

Hab. Among shrubs, etc., on dry spurs of hills near Matamau, County of Waipawa; 1882: *W.C.*

4. *G. multiglumis*, sp. nov.

Plant forming medium size tufts; leaves and culms of equal length, about 5 feet long, spreading, drooping. Leaves pale-green, narrow, almost linear, 4 lines wide at broadest, upper portion and tips excessively narrow, almost filiform, margined, slightly scaberulous below, more so above; culms leafy, straw-coloured. Panicle 3 feet long, slender, graceful, secund, compound, with about twelve compound (3-branched) drooping sub-panicles, the lower ones being 3–4 inches apart; floral bract dark-brown, appressed, enclosing 2 spikelets, small, very acuminate, arista extending length of spikelet; peduncle and pedicels flat, narrow, rigid, slightly scaberulous at edges, straw-coloured; pedicel length of spikelet; spikelet dark reddish-brown, broadly obovate, turgid, sub 3 lines long, possessing 9 scales, all shorter than spikelet or (immature) nut, 1-nerved, minutely and closely pubescent at tips; the 3 outer very small, half the length of spikelet, narrow, ovate, acuminate, tips sharp, diverging; the 3 next broadly ovate, acute, transversely wrinkled; the 7th scale is the largest, broadly oblong, apiculate, much concave and overlapping at base; the 8th oblong; the 9th (and terminal) narrow-

oblong or sub-lanceolate, and rather large for the innermost scale, and (with the 8th) apiculate and concave. Nut narrow, spindle-shaped, sub 4-sided at the middle, much grooved, 3 lines long, white, shining, black tipped, with base of style persistent, transversely ribbed within, ribs few, 6–7; style long, 2-branched, stigmatic branches 4, sometimes 5, blackish rough. ? Hypogynous scales ("filaments of anthors") 8, very long and fine, and excessively crinkled and compacted, both within spikelet around base of nut as well as outside, light red-brown.

Hab. Dry *Fagus* forests near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A species having pretty close natural affinity with the preceding species, *G. parviflora.*

A Note on the Genus **Gahnia.**

It is a curious fact that no modern botanical author has given any description of the anthers of *Gahnia*; indeed, they are not once mentioned or alluded to by them, not even when describing the genus or its species. Not by Brown, "Prod. Fl. Nov. Holl.;" nor by Kunth, usually so very complete, "Plant. Enum.;" nor by Hooker, in both "Fl. Nov. Zel.," and in the "Handbook Fl. N.Z.," and also "Fl. Tasm.;" nor by Bentham, in "Fl. Austral." Forster, however, who constituted the genus, does so, giving at the same time a characteristic drawing of the anthers of his type species ("Char. Gen. Plant.," tab. 26); at the same time Forster omits altogether the long "filaments." La Billardiere, who described two species, and has given plates of them with dissections in his large work, "Prod. N. H. Plant.," shows the anther; and in both Forster and La Billardiere there is also the peculiar and specifically distinct connective. In two of these species now described by me I have been able to give their respective anthers, in which their connectives also differ considerably, and thus afford a valuable specific character. Both Forster and La Billardiere, who describe the anthers and stamens of their species, show how very short the stamens are; which, however, by the latter are said to lengthen after flowering, but only (as shown in his plates) in a very limited degree. Subsequent botanical authors have said that this lengthening of the stamens forms those greatly elongated and crumpled "filaments" so highly characteristic of this genus. I have, however, my doubts as to whether those are not hypogynous scales (some of them at least), similar, only much longer and flaccid, to those of the closely allied genus *Lepidosperma.* At all events, such is really the case in two of the four species I have described in this paper, (*G. scaberula* and *G. exigua,*) in which are to be found, at the same time, both short stamens bearing anthers and those long crumpled "filaments"—which

are also "broad, flat, 1-nerved, and obtuse at tips." Moreover, the "stamens" or "filaments" are almost invariably represented as being three or four in number—sometimes, but rarely, six; I find them, however, to be usually double that number, viz., eight. I had both hoped and intended to have paid some close attention to this subject during this summer (1885–86), in their native woods, and in their proper season of first flowering, (which was also the reason of my not having more closely examined in that particular those species I have herein described,) but the great distance from me of their known habitats (nearly one hundred miles), and my time now being fully occupied with other matters, prevent my doing so. I would, therefore, recommend this study to those botanists in New Zealand who may have both time and opportunity of performing it; and that not merely for determining whether those elongated filaments (or some of them) are really hypogynous scales, but for the purpose of ascertaining the several forms of the connectives of the respective species.

Class III. CRYPTOGAMIA.*

ORDER IV. MUSCI.

Genus 46. **Polytrichum**, Linn.

1. *P. ruahinicum*, sp. nov.

Stems simple, erect, rather stout, sub-rigid, red, 1–2 inches high, about ½ inch of lower portion bare. Leaves numerous, spreading; lower slightly decurved, upper erect; linear-subulate, 5 lines long, smooth, softish, green, opaque, margin finely pellucid and sharply serrate to base; tips acute, brown; nerve stout; base much and suddenly dilated; basal cells minute, sub-orbicular, and double-walled, those of the dilated membranous portion larger, linear-oblong and rectangular, and single-walled. Fruit-stalk single, lateral, stout, 4½ – 5 inches long, stiff, red, glossy, very flexuous or tortuous (as many as sixteen large crinkles in a single seta). Capsule oblong, 3-sided, gibbous above, 2½ lines long, sub-erect, green, constricted below mouth, margin of mouth bright-red; operculum large, conical, very obtuse, pale; calyptra very small, reddish-brown, naked, base narrow and much lacerated, very slightly hairy near base and at extreme tip, but only perceptible under a good lens.

Hab. On sides of gulleys, eastern slopes of the Ruahine mountain range, County of Waipawa; November, 1885: *Mr. H. Hill.*

* The paper I had prepared containing Cryptogamic plants (*sp. nov.*), was read at the ordinary meeting of the Hawke's Bay Philosophical Institute held in September, 1885: however, these in this paper (with a few others) were since discovered, and being six notable novelties, I embrace this opportunity of early making them known.—W.C.

Obs. This is a very striking species of *Polytrichum*, from the extreme length of its tortuous, thick, and richly coloured seta; its leaves, too, are much more of a pleasing green colour than is usual in this genus; while its capsule and calyptra also differ from those of its New Zealand congeners. Its nearest ally among our known southern *Polytrichæ*, is *P. magellanicum*, Hedw., from which species, however, it differs considerably. It might possibly fall under *Polytrichadelphus*, C. Muell. (*Cyphoma*, Hook. fil. and Wilson). I have received several fruiting specimens of this plant from Mr. Hill, in various stages of advancement, yet all possessing the same peculiarly-formed seta.

Genus 71. **Hookeria**, Smith.

§ Pterygophyllum.

1. *H. macroneura*, sp. nov.

Plant 3–4 inches high, of very close growth, erect, creeping below, much branched, especially at top; stems thick, dark, somewhat woody, densely matted with dark-brown hairs and rootlets; branches flat, forked, spreading, decurved, ¾–1½ inches long, 5–7 lines wide; stalks thickish above and very hairy to tips; hairs patent, pellucid, white, jointed. Leaves pale-dusky-green, quadrifarious (or somewhat sexfariously disposed), imbricated, large, thin, very obtuse, not margined, the upper half finely serrate, the lower entire; lateral spreading, orbicular-ovate or broadly elliptic, 2 lines long, dimidiate; dorsal and ventral orbicular, 2 lines diameter; nerve very stout, extending throughout ¾ths of leaf, forked near tip, and sometimes shortly 3-branched there; cells large, oblong-orbicular, much longer at the basal portion, and very much smaller at the margins, strikingly possessing a minute triangular cellule in every angular junction. Perichætial small, sub-linear-ovate-oblong, rather suddenly acuminate, margin entire, tips truncate with 2–3 teeth, and also 2–3 small teeth near apex; cells linear-oblong, mostly 4-sided. Fruit-stalk 12–14 lines long, erect, flexuous; wiry, twisted, glabrous, dark-brown, thickened at top, very slightly muricated or roughish towards top beneath, thickened at base. Capsule oblong, 1½ lines long, dark red-brown, horizontal (much drooping when dry), largely tubercled at base, base thickened but not strumous; teeth, external, dark-brown, very acuminate, incurved, with two prominent dark distant dorsal ridges, and closely transversely barred throughout with denticulate margins, giving their long filiform tips a knotted appearance; internal, pale, acuminate, distantly barred, without intervening ciliæ.

Hab. On the ground, and on rotten sticks, edges of mud swamp; low dark woods near Norsewood, County of Waipawa; 1885: *W.C.*

Obs. A very fine species, having some affinity with *H. quadrifaria*, Smith; also *H. luteo-virens*, and *H. petrophila*, Col.,

but very distinct. Leaves remarkably crisp and contracted when dry, but quickly resuming their natural appearance on being wetted.

2. *H. maculata*, sp. nov.

Plant small, $\frac{3}{4}-1\frac{1}{4}$ inches high, erect, cæspitose, closely imbricate, much and sub-palmately branched; branches flat, broadest at top, decurved at tips; densely matted below with brown rootlets. Leaves sexfariously disposed, closely imbricate, broadly elliptic, $1\frac{1}{2}$ lines long, all nearly alike, spreading; young leaves pale green, when old spotted at tips of a bronze colour, or each tip bearing a round spot of that colour; margins entire, but under a high power delicately and regularly denticulate; nerve red, very stout at base, extending about $\frac{4}{5}$ths of leaf, slightly forked near tip; cells sub-orbicular, excessively small except at the centre from middle downwards; there large, open, increasing in size to base, the basal cells sub-quadrately-oblong. Fruit-stalk very short, $1\frac{1}{2}-2$ lines long, black, twisted, flexuous, glossy, thickened at base; few. Capsule minute, about $\frac{1}{2}$ line long, obovate-oblong, sub-erect (horizontal when dry), finely reticulate, sub-tuberculate, sub-apophysate, blackish-brown, glossy, thickened at base. Operculum and calyptra not seen.

Hab. Shaded spots, base eastern slopes of Ruahine mountain range, County of Waipawa; 1885: *Mr. H. Hill.*

Obs. An interesting little species; its regularly spotted appearance giving it a peculiar aspect. It differs much from the other New Zealand species of this genus, its nearest ally being *H. sciadophila*, Col. I have received a large tuft of it from Mr. Hill, containing many plants, but as there were only three fruiting specimens, I did not break up one of them to ascertain the structure of the peristome and perichætial leaves. When the old leaves below decay, or are gnawed by some insect, the red nerves are left, presenting another peculiar appearance.

Order V. HEPATICÆ.

Genus 7. Gottschea, Nees.

1. *G. dichotoma*, sp. nov.

Plant large, procumbent and sub-pendulous, dichotomous, 8–9 inches long, much branched; branches repeatedly forked, spreading largely, leafy, 1–5 inches long, $\frac{1}{4}$ inch wide, light-green, flaccid; stems stout, cylindrical, woody, blackish, naked and rigid below. Leaves somewhat distant, free, imbricated, oblong-ovate, finely serrulate; ventral (or under) obtuse, very thin, flat, not plaited, ciliate on upper basal margin; dorsal (or upper) wavy, rumpled, margins slightly irregular, upper basal portion very broad, round, and overlapping, apex very acute, free; in their axils 2–3 small, narrow scale-like leaves, much ciliated. Stipules large, nearly 2 lines wide, situate within (or

above) the junction of leaves with stem, sub-orbicular-ovate, deeply emarginate, the upper half slightly and irregularly cilio-serrate, the lower entire; stipules on branchlets sparingly ciliate; ciliæ jointed. Cellules very small, distinct, compact, of irregular sizes and shapes, mostly rounded, sometimes sub-rectangular, extending also into the teeth.

Hab. On a rotten stump, forming a large handsome hemi-spherical clump, completely hiding its support, and with nothing else growing mixed with it, in a forest swamp among fern trees (*Dicksonia squarrosa*), near Norsewood, County of Waipawa, and only seen in that one spot; October, 1885: *W.C.*

Obs. This is a remarkably fine species, perhaps our largest; it has close affinity with *G. nobilis*, Nees, and might easily be taken for it at first sight. It differs, however, in its much larger size, in its procumbent sub-pendulous habit, and in being repeatedly forked; also, in the different shape of its leaves (both lobes, the upper lobe being also waved and rumpled), in their being more distant and open, and much less and more finely serrulate; in the stipules also being entire in their lower half; and especially in the areolæ being of a widely different shape, very minute and distinct. Fruiting specimens not seen.

Genus 24. **Fossombronia**, Raddi.

1. *F. macrophylla*, sp. nov.

Plant creeping, rather large, spreading 2–3 inches each way, overlapping, much and dichotomously branched, succulent, very fragile. Branches stoutish, dark-coloured, with many dark-purple long rootlets below; branchlets 4–9 lines long, usually naked above in the middle. Leaves sub-erect, crowded, wavy and rumpled, highly membranous, papillose, shining, green, sub-reniform-quinquangular, 2½ lines broad above, sessile, amplexicaul laterally, margins sub-excised-sinuate, with about five small equidistant angles, sub-acute and minutely apiculate; tips of branchlets sub-rosulate; cells large, broadly-oblong and sub-orbicular-quadrate. Perianth large, erect, campanulate, open, wavy, margins slightly laciniate. Fruit-stalk erect, stout, 6–8 lines long, white; capsule globose, finely papillose, dark-purple; spores and elaters rich dark-brown; the helices of elaters minute and largely gibbous. On the capsule bursting, the broken shell is reflexed on the stalk, and the spores and elaters form a large globular ball.

Hab. Damp shaded spots, ravines, east slopes of Ruahine mountain range, County of Waipawa; 1885; *Mr. H. Hill.*

Obs. A species near to *F. nigricaulis*, Col.

Genus 28. **Podomitrium**, Mitten.

1. *P. smaragdinum*. sp. nov.

Plant dark-green, procumbent, of dense growth, slightly creeping, much and loosely overlapping and overgrowing; fronds

or lobes horizontal, drooping, scarcely sub-erect, very irregular, of various shapes and sizes, $\frac{1}{2}$ inch to 2 inches long, 2 lines broad, mostly ovate-acuminate and linear-ovate, obtuse and emarginate, sometimes stipitate, wavy and rumpled, smooth, shining; midrib stout, succulent, not clearly defined save at base, with fine, short, brown rootlets on the lower portion; margins thin, entire; frond much thicker on each side of the costa, tips often proliferous; sometimes several small fronds or lobes issue from a kind of flat rhachis, and then it possesses a somewhat sub-pinnatifid and forked appearance, lobes linear-acuminate; cells oblong, transverse. Fructification 1–3, from each side of midrib base of frond below. Involucre short, slightly tumid at base, with a few broad, obtuse, laciniate scales, shallow-cup-shaped, closely adhering, highly cellular, largely laciniate; laciniæ serrate, decurved. Perianth 3–3$\frac{1}{2}$ lines long, greenish with a purple-pink hue below, stout, slightly curved, smooth, shining, finely striate, cylindrical, narrowed and many plicate at apex, mouth laciniate; laciniæ long, slender, wavy; cells linear-oblong, barred. Fruit-stalks 1$\frac{1}{2}$–1$\frac{3}{4}$ inches long, stoutish. Capsule 1$\frac{1}{2}$ lines long, cylindrical, brown-purple, smooth, shining; valves linear, sub-acute, cohering strongly at tips after bursting; tips thickened; cells narrow-linear, thickened at ends. Elaters very numerous and long, twisted, enclosed, (somewhat like those of *Lejeunia* and *Pellia—teste* Dumort's figs.,) much implexed and crumpled, brownish, ends sub-acute; on the capsule bursting, the elaters remain in a largish globular, fluffy ball, covering the whole capsule. Spores orbicular, smooth, brownish-green, centre depressed, edges entire. *Male:* a few antheridiæ, sessile on each side of midrib below, under a broad sub-flabellate scale, margin sinuate and serrate, generally opposite in pairs and near the base, but sometimes on the stipe and sometimes scattered, 2–8 on a frond.

Not being satisfied with the comparatively low power of my own microscope, I applied to Dr. Spencer, who has an excellent and powerful compound one, (which he has also used so very effectually in describing the fresh-water *Algæ* of New Zealand in his papers in past volumes of "Trans. N.Z. Inst.,") and Dr. Spencer has very kindly examined the fruit, etc., of this little plant, and has also sent me the following interesting and copious description, which, with much pleasure, I bring forward here:—

"The elaters are very beautiful objects, they give one the idea of a double cord twisted into two helices; with a high power, a distinct but exceedingly fine membrane is seen surrounding the loops, not straight but following their sinuosities. The spores are circular, edges quite smooth, outline double, with cellular space between the two contours. Elaters, length $\frac{1}{83}''$, breadth $\frac{1}{1900}''$. Spores, breadth $\frac{1}{250}''$ to $\frac{1}{1900}''$." (Dr. Spencer *in litt.*)

Hab. On the earth at water's edge, in a deep, narrow, and dark glen (in which the sun never shines); forest, near Matamau, County of Waipawa (barren); 1883: and also in a swamp, in dense forest near Norsewood, same county (in fruit); 1885: *W.C.*

Obs. I. This species, though allied to *P. phyllanthus*, Mitt., differs pretty considerably from that plant, and that in several particulars—*i.e.*, from its description as given in "Flora N.Z.," and in the "Handbook Fl. N.Z.," and from the drawings and dissections of that plant, with description, as originally given by Sir W. J. Hooker in his "Musci Exotici." There is, however, another and similar plant, (discovered here in New Zealand by myself, and fully described by Hook. fil. and Taylor, in the "London Journal of Botany," 1844, as *Diplolæna cladorhizans;* and afterwards described in the "Synopsis Hepaticarum" as *Blyttia cladorhizans,*) to which this present one is very much more closely allied. But Mitten, in those two works on New Zealand Botany above named, has subsequently united those two plants (formerly "2 species and 2 genera") as being but one species: to this, however, I cannot agree. And it is worthy of notice that both Sir J. D. Hooker and Dr. Taylor, who well knew those two plants and published them, had considered them to be very distinct; although, from what they say, they evidently had not seen *Diplolæna cladorhizans* bearing perfect fruit: moreover, those able cryptogamists, the authors of the "Synopsis Hepaticarum," while disagreeing as to their being two genera, made two distinct species of them. For my own part, I think that Mitten has united two plants under his *Podomitrium phyllanthus* (l.c.), which, by his own showing there, might very easily be done. But be that as it may, of one thing I am pretty sure, that this plant I have now described in this paper is a very different one from that originally discovered in New Zealand (Dusky Bay) by Dr. Menzies, in 1791, and published by Sir W. J. Hooker in his "Musci Exotici" as *Jungermannia* (*Podomitrium*) *phyllanthus.*

Obs. II. This little novelty has caused me no little labour and research; for from my first detecting it in its darkish home (a deep rift in the earth at the head of a low forest gulley between two mountain spurs, a place, too, very dangerous of access, or, rather, to get out from, owing to its perpendicular and crumbling sides and nothing serviceable to lay hold of), I believed it to be something new; but it was barren, and not unlike other and known small frondose *Hepaticæ;* subsequently I sought flowering specimens in that spot but failed. I was much pleased in again unexpectedly meeting with it in a new locality, and beginning to show fruit! I brought a good sized portion carefully away, and in about a month it became fully developed.

ART. XLV.—*A brief List of some British Plants (Weeds) lately noticed, apparently of recent Introduction into this Part of the Colony; with a few Notes thereon.*

By W. COLENSO, F.L.S., etc.

[*Read before the Hawke's Bay Philosophical Institute, 14th December*, 1885.]

IN my travels or wanderings on foot during the last 2–3 years, mostly in and about the Seventy-mile Bush and its neighbouring localities, I have occasionally stumbled on a British plant that I had never seen before in New Zealand, that is since I left England, upwards of fifty years ago. On three occasions in particular I was at first, and for some time after detecting the plant, induced to believe that I had gained something additional to our indigenous Flora; but on examination, etc., I found out my mistake. I shall, however, only mention those few that are of recent introduction, at least here in Hawke's Bay; as far too much, in my opinion, has been already often said and repeatedly published respecting those British and Australian weeds, which have long been established in New Zealand, some of them even before it became a British colony! otherwise I might easily do as others have done before me: make out a long and wearisome reiteration or useless catalogue of hard names.

On the contrary (and as Sir J. D. Hooker in writing on this subject has shown), an increase of knowledge, if not a real benefit, is obtained, by noting the fact of the *introduction* or *first notice* of any of our Home and foreign common weeds into the colony.

Ranunculaceæ.

Ranunculus hirsutus, Curt. (Pale Hairy Crowfoot). Only *one* plant, and that a very large one, quite a little erect bush of above a foot high, containing very many flowers. (This is one of the three plants already alluded to, that on first sight I supposed to be indigenous, it had so much in common with our larger New Zealand *Ranunculi*.) In an open sunny watercourse near Norsewood; 1884.

Cruciferæ.

Coronopus didyma, Sm. (Wart Cress). A single plant only, but a pretty large prostrate one. This plant is not generally spread at Home, being confined to the south-west of England. I found this during the present summer (1885) at Napier.

Camelina sativa, Crantz. (Gold-of-Pleasure). Of this also I only detected a single plant, and that a few years ago near Napier; it was of large size (for the species) and full of flowers and fruit; I have not observed it since. I gathered and dried the whole of it. Its common English name seems wonderfully misplaced.

Lineæ.

Linum angustifolium, Huds. (Narrow-leaved pale Flax). First observed this summer here in Napier.

Hypericineæ.

Hypericum androsæmum, Linn. (Tutsan; Park-leaves). One fine plant only here at Napier, in my field; first observed at Christmas, 1884, bearing flowers and fruit.

Umbelliferæ.

Torilis nodosa, Sm. (Knotted Hedge Parsley). One small plant only seen, and that in a very strange out-of-the-way spot for a foreign weed to be found in, at the base of a high cliff, side of the River Mangatawhainui, Seventy-mile Bush; 1884. This little plant gave me some trouble; for, on my first meeting with it (young and leaves only), I supposed it to be *Daucus brachiatus*, Sieber, (an indigenous common northern plant that I had never met with in these parts,) or, something new; so I watched it carefully. On a subsequent visit I procured a tiny bit in flower, and on a still later visit its curious fruit, when I soon found out what it was.

Rubiaceæ.

Galium aparine, L. (Goose-grass, or Cleavers). This fine species of *Galium* grows strongly here at Napier. First noticed in 1884.

Compositaceæ.

Crepis pulchra, Linn. (Small flowered Hawk's Beard). Sparingly in my field at Napier.

Crepis tectorum, Linn. (Smooth Hawk's Beard). With preceding; this plant becomes a biennial in New Zealand. At first I had supposed this plant to be a *sp. nov.*, from its large size and woody stems, and being a perennial.

Hypochæris glabra, Linn. (Smooth Cat's-ear). With preceding; first noticed in 1884.

Lapsana communis, Linn. (Common Nipple-wort). In one spot only, in an open grassy glade in a thick wood, south of the River Mangatawhainui, near Norsewood; first noticed in 1883.

Arctium lappa, Linn. (Burdock; Clot-Bur). I first saw this plant in 1882, in a dense and unfrequented part of the Seventy-mile Bush. There was only one plant of it, a young one, having 2–3 large prostrate leaves resembling rhubarb. I could not tell what to make of it! I gazed on it with astonishment, much like Robinson Crusoe on seeing the print of a human foot in the sand! I had seen nothing like it in New Zealand. [To the best of my recollection I had never seen the burdock growing in England.] I visited that one plant several times during the first six months, with great expectations, but

could make nothing of it, as during that period it showed no signs of flowering. Subsequently, however, it flowered. I collected and dried specimens, and brought them to Napier, not, however, without some amount of misgiving. On due examination, I found out what it was. Unfortunately I did not go again to those localities until the following Spring; and, as it had seeded plentifully, and the cattle had got into that wood, they carried off its sticky burs in all directions; so that from that *one* plant hundreds have been disseminated, filling the neighbourhood with a much worse weed than the introduced thistle. Like many other of the foreign weeds, it flourishes exceedingly, and grows to a very large size, 4 feet high, thick, bushy and strong, insomuch that a few plants growing together offer quite an obstacle to the traveller that way.

Among sundry other plants of this extensive and easily introduced Order, that have also found their way here during the last few years, (although previously known in other parts of the colony,) may be mentioned :—

Chrysanthemum leucanthemum, Linn. (Great Ox-eye). In great quantity about Waipawa and Waipukurau, quite whitening the fields at Woburn with its flowers.

Achillea millefolium, Linn. (Common Yarrow or Milfoil). At Norsewood; where, however, it bears purple flowers, and looks well.

Centaurea solstitialis, Linn. (Yellow Star-thistle; St. Barnaby's Thistle). Napier.

Labiatæ.

Prunella vulgaris, Linn. (Self-heal). This weed, long known in the north of New Zealand, I first noticed about five years ago, and then only a few, and in two or three adjoining spots. When I first saw it, being young and only showing leaves, I did not recognise it. On a subsequent visit it was in flower. In the following year I was again sojourning in that same locality (Seventy-mile Bush), when one day a gentleman drove up to the house where I was; he had been up in the forest collecting ferns and plants for his garden, and among others he had carefully taken up some young *Prunella* plants; but on my telling him what they were, he quickly abandoned them. This plant, too, has spread wonderfully in a short time, supplanting, overrunning, and destroying the low indigenous herbs; which is the more easily done through it being a perennial.

Art. XLVI.—*On* Clianthus puniceus, *Sol.*

By W. Colenso, F.L.S., etc.

[*Read before the Hawke's Bay Philosophical Institute, 14th December*, 1885.]

For many years this truly handsome plant has at various times largely occupied my thoughts. Partly from its great beauty and comparative variety; partly from the large and cosmopolitan Order to which it naturally belongs, *Leguminosæ*, (so common in the neighbouring countries of Australia and Tasmania,) being so poorly represented in New Zealand; and partly from its genus being small and almost endemic. Indeed, I might go almost a step further, and add, that there is a kind of veil or mystery shrouding it, which hereafter may be clearly explained. In few words, that "mystery" is this: that I have never met with it growing truly wild and common, as all the other indigenous plants are found, although it may have been, like some of our genera, originally confined to one special area. Indeed, I think that, had it not been early raised from seed and generally cultivated by the colonists, (as well as at Home,) it would very nearly have become extinct, like some other New Zealand plants. And in this respect it seems to me to belong to that small class of esteemed plants that were long and assiduously cultivated by the ancient Maori people—viz.: the Taro (*Colocasia antiquorum*, Schott.), various sorts; the Kumara, or sweet potato (*Ipomœa chrysorhiza*), many varieties; the Aute (*Broussonetia papyrifera*), Paper Mulberry; the Tamure, or Awanga (*Phormium colensoi*), var., striped New Zealand Flax; and the Tipara (*Cordyline*, sp. undescribed), Broad-leaved Cabbage-tree. In one or two points, however, the *Clianthus* differs widely from them: (1) It bears seed abundantly; and, (2), it flourishes in almost all spots where it has been planted. Yet, in connection with this, I may observe that, although I have not unfrequently noticed a large shrub of *Clianthus* bearing hundreds of fruitful pods of seeds, that were left on the plant to ripen, burst, and fall to the ground, I have scarcely seen an instance of any of those many seeds springing spontaneously from beneath or around the parent plant; and this great peculiarity obtains also in a large measure among the *Phormium* species.

On my arrival in New Zealand, (Bay of Islands, 1834,) I first saw this fine plant in full bloom in the gardens of the missionaries; naturally I was struck with its imposing appearance, as I had never seen it, nor anything like it, before; indeed at that time it was scarcely known at Home. I very soon cultivated it in my own garden. In all my travels at the North, extending over several years, and crossing and recrossing the country in all directions, I never met with the *Clianthus* growing

wild or naturally, save on two or three of the smaller islets in that Bay,—notably on a small islet named Taranaki, in the mouth of the Kerikeri River. I have also seen it occasionally in deserted food plantations, and near the residences (occupied or abandoned) of the old Maoris; still it was a plant very well known among them.

The plant, however, was early seen in New Zealand by Cook and his co-voyagers, on his first voyage, and no doubt on this East Coast, and perhaps more than once at the different places where he touched and went on shore on that voyage, the time of the year being that of the flowering season of this plant—as at Tolaga Bay, Mercury Bay, and the Bay of Islands. Specimens of the plant were at that time taken Home by Sir Joseph Banks and Dr. Solander, and the plant was named *Clianthus puniceus* by Dr. Solander, who established its genus. Forster, who accompanied Cook on his second voyage, (and who has done so much towards making known the botany of this country,) probably never saw it, although here in the proper season for observing it, as his visits were confined to the South Island, where, I have reasons for believing, the plant was not originally found. The more modern botanists, also, as Lesson and Raoul, whose researches and discoveries were mainly confined to the South Island, make no mention in their works of having met with it; and the two Cunninghams, who were also early in New Zealand at the North, and who spent some time there (especially Richard Cunningham), also never saw it.

However, it was first published by George Don, in 1832, in his "General System of Botany," who changed its original name of *Clianthus* (known also to him) to *Donia punicea*. His description of the plant is a good one (a portion of its character I extract):—"*Vexillum* ovate-lanceolate, acuminate, rather shorter than the keel, reflexed; *Wings* lanceolate, acuminate, half the length of the keel," etc. "Native of New Zealand, where it was first discovered by Sir Joseph Banks and Dr. Solander, who gave it the name of *Clianthus puniceus*." (*loc. cit.*, vol. ii., p. 468.) Of course, Don could only have known of those New Zealand specimens from which he drew up his description; he does not say why he changed the name of the plant given to it by its discoverer, which, curiously enough, he also gave *his own name* to! though he says it was "named in honour of Mr. George Don, of Forfar," his own father.

This was followed by Dr. Lindley, in 1834, in a more elaborate account of this plant, in a paper "read December 2, 1834," before the Horticultural Society of London, and published in 1835, in their "Transactions," 2nd series, vol. i., p. 519, accompanied with a large and well executed coloured drawing of it, from the pencil of the celebrated flower painter, Miss Drake. This drawing, I may further observe, was taken from

a fresh specimen of the plant "raised in England from seed gathered by the missionaries in New Zealand, where it is said to be called 'Kowhaingutu-kaka,' or Parrot's-bill, and to grow to the size of a large tree" (*sic*)—"in England, however, it has not reached beyond 4 feet in height." The coloured drawing of the plant is a bold, clear, and good one, and shows the flowers much as Don had described them, with their "wings lanceolate and acuminate." At that time Dr. Lindley restored to the plant its original name of *Clianthus puniceus*, which it has properly retained ever since.

During my early visits to the East Coast, but always late in the summer, (1838–1843,) landing at Wharekahika (Hicks' Bay), and travelling on foot to Poverty Bay, in and out among the Maori villages, I noticed a few scattered plants of *Clianthus*, though much as I had formerly seen them in the North.

In 1844 I came to Hawke's Bay (second time) to permanently reside, and it was not very long before I obtained plants of *Clianthus* (from seed or cuttings) from the Maoris for my garden. In due time, when these grew and flowered, I noticed a marked difference between their flowers and those of the northern plant, with which I was so well acquainted. At first I did not pay great attention to it, having vastly too much of other and more important matters to attend to, but in course of time, and as my plants grew so tall and to such a large size, I examined them a little more closely, and then I discovered what I believed to be a true specific difference, or, at all events, showing a marked variety, if the newly-detected characters should prove constant. Somewhere in the decade of 1840, I sent specimens of this southern form of *Clianthus* (with other plants) to Kew, to Sir W. J. Hooker, calling his attention to the differences I had noticed; in the course of (say) the following year, Sir W. J. Hooker, in reply, said that they at Home who had examined the dried specimens sent could not detect any material difference.

After that time the matter slept, as far as I was concerned. Of late years, however, having the southern form (as I call it) always here in my own garden, and seeing it generally plentifully cultivated in gardens in this town, and in the adjacent country villages and other places, I have been led again to closely examine the plant, and I have found that those differences I had formerly detected still continued. I, therefore, obtained both seeds and plants of the northern form from Auckland, and this year the plants have flowered in my garden; and now, having the opportunity of comparing closely the two forms in a living state, I give briefly the result of my old and new examinations, which will serve sufficiently to point them out.

1. *Clianthus puniceus*, Sol. (*vera*: N. form).

Flower 3 inches long, 1¼ inch broad; standard ovate, very

acuminate, sides nearly straight, claw long; wings lanceolate, acuminate, acute; colour a clear lively scarlet.

2. *Clianthus maximus*, Col. (S. form).

Flower 2–2¼ inches long, 1½ inches broad; standard broadly ovate, acuminate, sides rounded, claw short; wings somewhat oblong, broad, very obtuse (rounded) at apex; colour a less clear red, verging to more of a dark or crimson hue, with a large dark spreading blotch at base of the standard; flower broader; and the substance of the petals, especially the keel, thicker, more coriaceous or skinny, and finely wrinkled. The leaves also of this species are larger, some leaflets measuring more than two inches; these are also more membranous and glabrous than in the northern form; and the whole plant is stouter, rises higher, generally from 6 to 10, or even 12, feet.

The principal differences, however, which are clearly apparent at first sight, (especially if the flowers of the two forms are compared together in a living state), consist in their relative sizes, in the shape of their standards, and more especially in their wings, and also in their colours; but whether those differences, though constant, are sufficient to constitute two separate species, or merely varieties, is of little consequence to me—the two forms exist.

And here I may further remark (having very frequently of late years noticed it), that several of our indigenous New Zealand plants, and in particular of genera of which it had always been believed that New Zealand possessed but *one* species of each genus, have now, at least, *two* species to each genus; or if not exactly (and beyond all controversy) two species, seeing that the limit of a species can scarcely be clearly defined, then two forms; the southern form being very distinct from the northern one, yet pretty closely resembling it in general appearance. And this I have especially noticed to take place in the Orchid Order: *e.g.* Dendrobium, Sarcochilus, Bolbophyllum, Gastrodia, Earina, Microtis, and Orthoceras; to which may be added Gratiola, Dianella, Arthropodium, Tupeia, Australina, Hoheria, and many others.

To this mysterious subject, however, of dimorphism (found here again in *Clianthus*), I hope to return on some future occasion.

In conclusion, I may add, that Lindley's description of *Clianthus puniceus* agrees with the coloured drawing of the English cultivated one already referred to, in which the *alæ* or wings are correctly shown to be lanceolate acuminate with acute tips. A. Cunningham's description of the same, in his "Prodromus Novæ Zealandiæ," (published several years after, 1839), in "Annals of Natural History," vol. iii., p. 246), is drawn, as he shows, from two sources, the one being "Solander's MSS,

in Bibl. Banks," and the other Dr. Lindley's description already mentioned; as at that time of Cunningham's writing his valuable paper in England, he had not seen the plant growing in New Zealand,—although he did afterwards in my garden and elsewhere. Sir D. Hooker, in his "Flora Novæ Zelandiæ," in describing *Clianthus puniceus* gives the following: (1. of the genus), "*Vexillum* ovatum, incumbens v. reflexum, carinam oblongam cymbiformem æquans: *alæ* lanceolatæ, basi exciso auriculatæ, carina breviores:" and (2. of this species), "*Standard* ovate, slightly recurved, as long as the keel. *Wings* lanceolate, sub-falcate, sharp, twice as long as the standard, 1½ - 2 inches long." Here, however, while his description of the shape of the wings is quite correct, and in agreement with both Don and Lindley, above, viz., "*Wings* lanceolate, sharp;" there is a manifest error with regard to their size—"twice as long as the standard." This latter is corrected in his "Handbook," published several years after (1864), and altered to "half as long as the standard;" while the former description of the shape of the tips of the wings is also altered from "sharp" to "acute *or obtuse;*" evidently, as I think, to embrace the two states or forms (whether species or varieties) to which I had early called his attention.

Napier, December 10th, 1885.

P.S.—Living flowers of both plants, with mounted dissections showing the diverse forms of their parts, as described in this paper, were exhibited at the ordinary meeting of the Hawke's Bay Philosophical Institute in October, 1885.—W.C.

ART. XLVII.—*Description of New Species of Native Plants.*

By D. PETRIE, M.A.

[*Read before the Otago Institute, 9th June, 1885.*]

Cotula goyeni, n. sp.

A MINUTE, prostrate, creeping herb.

Stems very short, clothed by the leaves, and woolly below their insertion.

Leaves broadly-oblong, ⅛ - ⅓ inch long; upper half cut into 5–7 linear lobes directed forwards, greyish-green; lower half entire, membranous, scarious, 1-nerved, more or less pubescent on the margin and outer surface.

Heads small, subsessile or sessile at the tips of the branches; peduncles very short (rarely exceeding ⅛ inch), woolly or pubescent; bracts in one or two series, ovate-oblong, obtuse, dark-purple at the edges: outer florets, female in one series; inner hermaphrodite; style crowned by a thin disc-like flattened stigma, in both female and hermaphrodite flowers; stamens

exserted, and style still larger than the stamens. Achene not seen in the mature form, but apparently glabrous.

Hab. Old Man Range, 5,000 feet; and Mount Pisa, 5,000 to 6,000 feet.

A very peculiar species, having considerable affinity to *C. pectinata*, Hook. fil. The most remarkable point in its structure is the capital flat-topped stigma, which is common to both kinds of flowers. In some specimens the stigmatic disc shows traces of a division into two lobes, but I have seen none with anything like two branches to the style. *Cotula maniototo* (mihi) in this respect approaches the present species, for in all its hermaphrodite flowers the stigma is capital and flat-topped. The flowers of the outer row, on the other hand, have in *C. maniototo* two short arms to the style.

If this peculiarity should prove constant in the present species, and it should continue to be regarded as a *Cotula*, the character of the genus as now formulated will require modification. I was unfortunately unable to procure mature achenes, as my specimens were gathered about the middle of February; the mature fruit might be got in March. The plant is very common on the top of the Mount Pisa Range, and less so on the Old Man Range, above Deep Creek.

Myosotis cheesemanii, n. sp.

A small, branched, hispid perennial.

Stems several, slender, ascending, about 1 inch in length, densely hispid.

Radical leaves 7–9 lines long, spathulate-oblong, acute, 3-nerved near the base, the upper half coriaceous, the lower membranous, everywhere densely hispid with appressed stiff hairs, except on the lower third on the inner face, which is glabrous.

Cauline leaves similar, but narrower, shorter, and more acute.

Flowers, 1–4 on each stem, solitary or in pairs in the axils of the upper leaves, shortly pedicelled, 5 lines in length.

Calyx densely hispid with appressed hairs, shortly 5-lobed, the lobes acute.

Corolla white, the tube twice as long as the calyx, limb about 3 lines across.

Anthers not exserted, style projecting nearly one line beyond the corolla.

Nuts in pairs, narrow-ovate, lenticular, smooth and polished, dark-brown, with narrow wing-like ridges.

Hab. Mount Pisa Range (6,000 feet), on steep faces of shingle above the snow-drifts.

A most beautiful little plant. The flowers are conspicuous, and large for so small a plant. They have also a strong and agreeable odour, and are much frequented by insects, by which

their fertilisation is doubtless effected. I have much pleasure in dedicating the species to Mr. T. F. Cheeseman, F.L.S., who has done much to elucidate the New Zealand species of the genus.

I have a form of this species from Mount St. Bathan's (4,500 feet); and Mr. G. M. Thomson informs me that he has gathered the same on the Rock and Pillar Range at an altitude of 4,000 feet.

Carix berggreni, n. sp.

Small, loosely tufted, reddish-brown.

Culms very short, $1\frac{1}{4}$ – 2 inches long, flattened above, shorter than the leaves, and enclosed to the base of the head by thin broad sheathing bases.

Leaves red-brown, 2–3 inches long, flat linear, of uniform width throughout the blade, obtuse, not serrate, finely and closely striate; bases paler, membranous, sheathing, twice as broad as the blade.

Spikelets 3, unisexual; two lower female, uppermost wholly male, approximate, stout, each 3 lines long, on short slender pedicels; bracts leaf-like, sheathing, diminishing in the upper spikelets.

Glumes broadly-ovate, shorter than the utricles, membranous, obtuse, rarely mucronate, entire, 1-nerved, with dark-brown streaks and blotches.

Utricles turgid, bi-convex, elliptic-oblong, not beaked, shortly bifid, spreading, very faintly nerved, dark-brown or black above, elsewhere green.

Branches of the style, 2. Fruit, 3-angled.

Hab. Mount Pisa Range, at the head-waters of the Luggate Creek, 4,000 to 5,000 feet.

This is a most distinct species. It is most nearly related to *C. uncifolia*, Cheeseman, but its short red-brown obtuse ensiform leaves readily distinguish it from all its congeners in New Zealand. The male spikelet is somewhat larger than and not so stout as the female ones. Named in honour of Dr. Sven Berggren, of Upsala University, who has described and figured several New Zealand species of the genus.

Carex kirkii, n. sp.

Small, densely tufted, grass-like; forming low tussocks $1–2\frac{1}{2}$ feet in diameter.

Culms $\frac{1}{2}$ – 1 inch long, very slender, much shorter than the leaves, and enclosed in their sheathing bases.

Leaves 3–5 inches long, filiform, involute, slightly striate, pale-green, with short broad membranous sheathing bases.

Spikelets 3–5, forming a compact ovoid head 6–9 lines long, sessile, closely approximate, female below, male above, few-flowered; bracts variable, the lowermost usually leaf-like, the upper glume-like, all shortly sheathing at the base.

Glumes ovate-lanceolate, acute, entire, membranous, pale at the top and edges with prominent green midrib, slightly larger than the utricles.

Utricles ovate-lanceolate, plane-convex or concave-convex, sub-stipitate, many-nerved, with recurved wings and tapering, bifid, serrate beak.

Branches of the style, 2, long.

Hab. Mount Pisa Range, at the head-waters of the Luggate Creek, 4,000 to 5,000 feet. Male flowers are sometimes absent in the lowermost spikelet. The foliage, though somewhat harsh, is readily eaten by sheep.

This species is allied to *C. muelleri*, mihi, = *C. viridis*, mihi, and *C. kaloides* (mihi). Named in honour of Mr. T. Kirk, F.L.S., a veteran worker in the Flora of New Zealand.

Carex thomsoni, n. sp.

Small, tufted, pale-green.

Culms very short, ½ – ¾ inch long, much shorter than the leaves, and invested by thin sheathing bases.

Leaves 1¼ – 2 inches long, linear, tapering upwards, acute, flat, deeply striate, finely serrate towards the top, their bases membranous, sheathing, and twice as broad as the blade.

Spikelets 3, crowded, female below, male above, forming a compact head ¼ – ⅓ inch long; bract short, ovate, mucronate.

Glumes ovate, acute, 3-nerved at the middle, membranous, entire, dark-brown at the margin, as long as the utricle.

Utricles lenticular, ovate or elliptical, broadly winged, shortly stipitate, nerved, with bifid beak, the upper half finely serrate.

Arms of the style, 2.

Hab. Mount Pisa Range, 5,500 to 6,200 feet.

The male flowers occur chiefly at the top of the uppermost spikelet; they are rare on the lowermost, less so on the middle one. The plant forms small low tufts, 3–5 inches in diameter. Flowering or fruiting specimens are not by any means easy to find. It is very common in the most exposed situations on the very crown of this wind-swept range.

Named in honour of Mr. G. M. Thomson, F.L.S., of Dunedin.

Carex muelleri = *C. viridis*, mihi.

My friend Sir Ferdinand von Mueller has pointed out to me that the specific name *viridis*, which I attached to a species of *Carex* described in vol. xiii. of the "Transactions of the New Zealand Institute," has been already used to designate a plant from Mexico. I have now very great pleasure in associating the name of that distinguished botanist with this interesting plant, in recognition of his great services to the science and of many kindnesses to myself.

ART. XLVIII.—*On the Classification of the* Algæ.

By R. M. LAING, M.A.

[*Read before the Philosophical Institute of Canterbury, 6th August*, 1885.]

Plate XA.

MANY attempts to classify the *Algæ* have been made, and though of late years our knowledge of this division of plants has greatly increased, yet it cannot be said that their relationships to each other have been satisfactorily made out. The older botanists were content with dividing them into two genera, *Conferva* including all fresh, and *Fucus* including all salt water forms. Harvey was the first to divide them into three groups, according to the supposed colour of their spores, thus: *Chlorospermeæ* (green-spored), *Melanospermeæ* (olive-spored), *Rhodospermeæ* (red-spored). In these divisions he has been followed by Sir J. D. Hooker, up to the present day.

Decaisne divided the *Algæ* into *Synsporeæ* (united spores, the modern *Conjugateæ*), *Aplosporeæ* (spores simple, not motile, green or brown), *Choristosporeæ* (separated spores, motionless, red, developed in fours). The next classification was that of Thuret; his divisions are well known: (1.) *Zoosporeæ*, (2.) *Chlorosporeæ*, (3.) *Phæosporeæ*, (4.) *Fucaceæ*, and (5.) *Florideæ*. In 1872, Cohn proposed to abolish the distinction between *Algæ* and *Fungi*, and form them into parallel lines. In 1875, Sachs said the classification of the *Algæ* was in the utmost confusion. He gave a new classification, improved upon in 1882, grouping the different divisions of the *Algæ* thus:—

Class A.—PROTOPHYTA.

I. *Cyanophycaceæ*.
(*Phycochromaceæ*, Prantl.
II. *Palmellaceæ* (in part).

Class B.—ZYGOSPOREÆ.

I. *Pandorineæ*.
II. *Conjugateæ*.

Class C.—OOSPOREÆ.

I. *Sphæroplea*
II. *Cœloblasteæ*
III. *Œdogonieæ*
} Product of fertilization, a resting spore.

IV. *Fucoideæ* { Product of fertilization, a new individual.

Class D.—CARPOSPOREÆ.

I. *Coleochæteæ*.
II. *Florideæ*.
III. *Characeæ*.

In 1880, Mr. A. W. Bennett, in a paper read at the Swansea meeting of the British Association, proposed the following classification:—

THALLOPHYTES.

I. *Protophyta* { *Protomycetes.* / *Protophycaceæ.*

II. *Fungi* { *Zygomycetes.* / *Oomycetes.* / *Carpomycetes.*

III. *Algæ* { *Zygophyceæ.* / *Oophyceæ.* / *Carpophyceæ.*

Then he proposes to subdivide the *Zygophyceæ*, the *Oophyceæ*, and the *Carpophyceæ* thus:—

A. ZYGOPHYCEÆ.

1. *Pandorineæ.*
2. *Hydrodictyeæ.*
3. *Confervaceæ.*
4. *Ulotrichaceæ.*
5. *Ulvaceæ.*
6. *Botrydiaceæ.*
7. *Conjugateæ.*

B. OOPHYCEÆ.

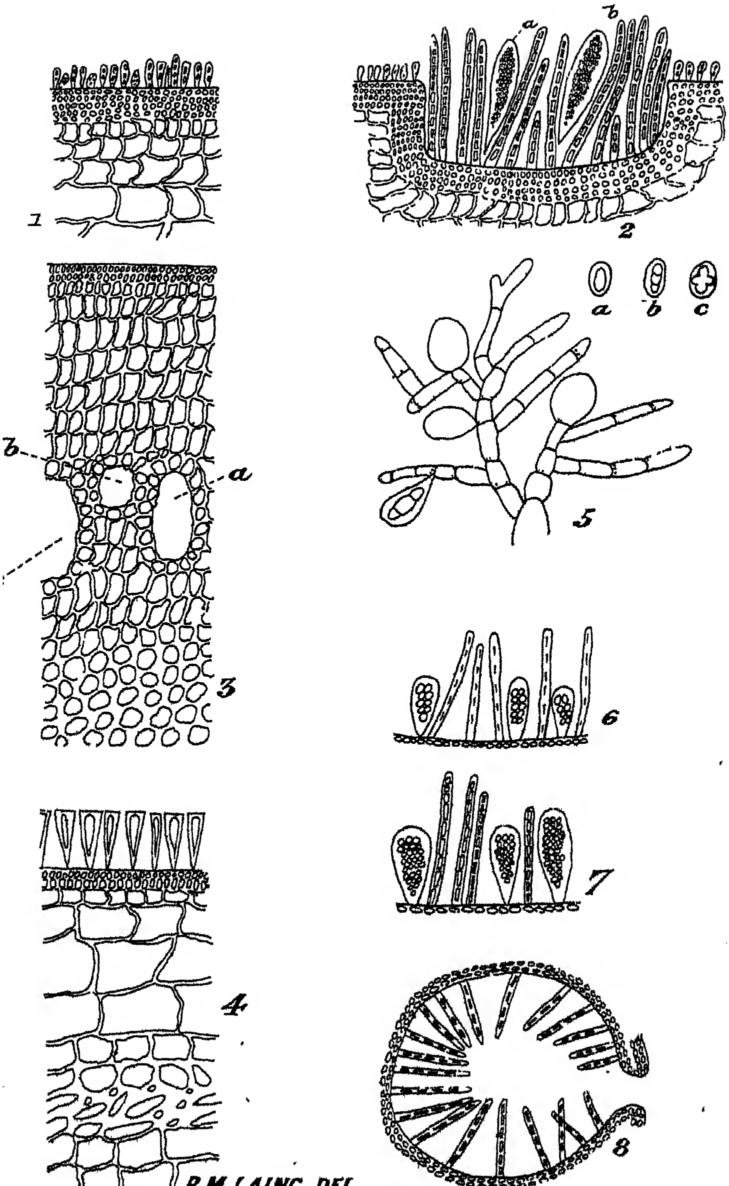
1. *Volvocineæ.*
2. *Siphoneæ.*
3. *Sphæro-pleaceæ.*
4. *Œdogoniaceæ.*
5. *Fucaceæ.*
6. *Phæosporeæ.*

C. CARPOPHYCEÆ.

1. *Coleochæteæ.*
2. *Florideæ.*

The earlier classifications need not be considered, as they will doubtless be superseded by those of Sachs and Bennett. But even the systems of these two last mentioned botanists appear to me to be open to several objections.

(1st.) By both, the *Phæosporeæ* are placed amongst *Oosporeæ*, though probably nearly all of them are reproduced by conjugation. (2nd.) Again, by both the *Hydrodictyeæ* are separated from their nearest allies, the *Volvocineæ*. (3rd.) Sachs places the *Botrydiaceæ* under the *Oosporeæ*, but conjugation alone is known in them; while Mr. Bennett separates them widely from the *Siphoneæ*, which are undeniably their nearest relations,



R.M.LAING .DEL.

To accompany Paper by R.M.Laing.

(4th.) The *Confervaceæ* are widely separated from the *Sphæropleæ* by both Sachs and Bennett; but these two orders differ only in their mode of reproduction, whilst they closely resemble each other in general structure and appearance.

It seems to me that the principal cause of error in these two classifications is the idea that all the *Oosporeæ* must be closely related, for behind this idea is the belief that fertilization has arisen only once in the vegetable kingdom; that is to say, that all plants which are reproduced by fertilization are descended from a common stock. But this scarcely appears to me to be correct, for fertilization has evidently arisen independently in the animal and vegetable kingdoms, as it is not found in the *Protozoa*, or the *Palmellaceæ*, the lowest divisions of each kingdom. Again, looking at the *Algæ* themselves, we see that fertilization is not the same process in all. The oospheres of *Fucus*, for example, differ considerably from the oospheres of *Vaucheria;* but, at the same time, the structure of the stem in the two genera is totally dissimilar. Now, it is much easier to suppose that fertilization has arisen independently in these two groups, than that they have diverged from a common ancestor, reproducing itself in this way. For it can scarcely be doubted that fertilization first originated in conjugating zoospores. We have only to suppose (and the supposition is perfectly warrantable) that an advantage was gained by a specialization of the functions of the two cells; the one increasing in size and becoming passive, the other remaining small and motile, since it would have to penetrate into the interior of its companion cell. Through some such variation as this, fertilization might easily have arisen on various occasions.

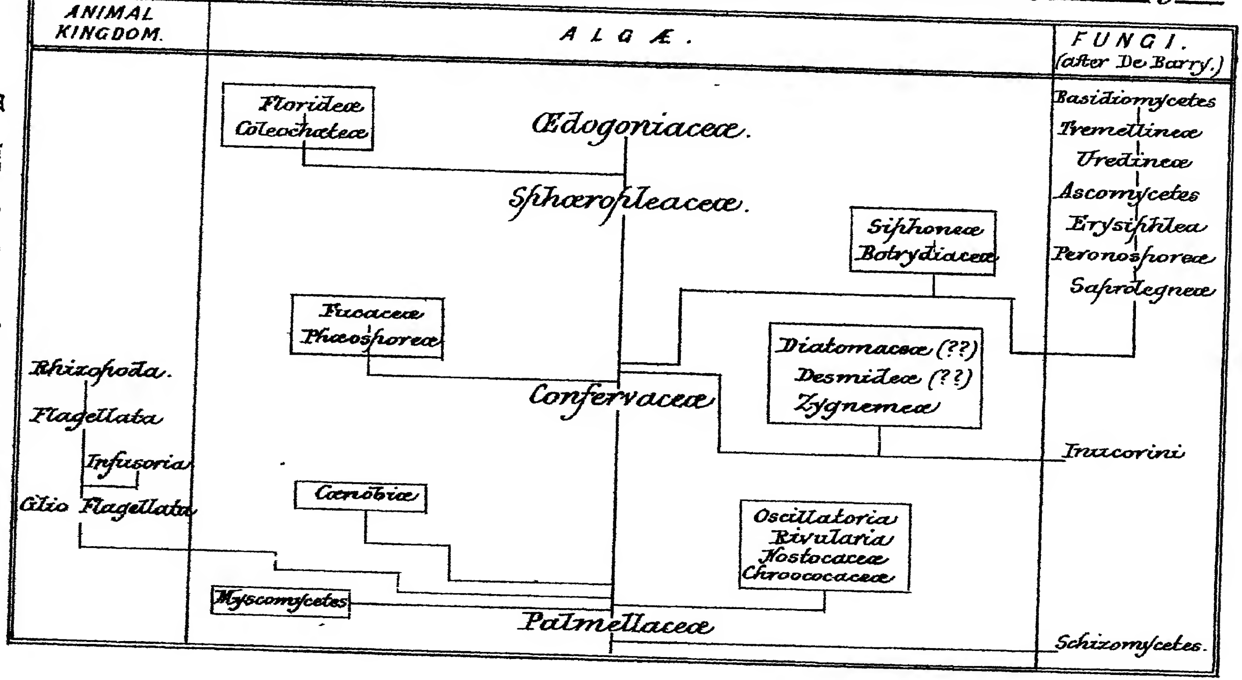
One more objection might be taken to Sachs' classification of the *Algæ*. He has included the *Characeæ* under the *Carposporeæ;* though it appears probable that they should stand by themselves. Perhaps they are degenerate forms of a higher type; for it is only in habit and, to some extent, in structure of stem, that they at all resemble the *Algæ*; and we know that many freshwater plants have become much simplified in structure (*e.g. Marsilia* and many of the *Naiadeæ*). A plant living in water has no need for a stem built up of many tissues. The simplicity of the stem of *Chara* does not necessarily therefore connect it with the *Algæ*, and its reproduction, on the other hand, can scarcely be compared with that of the *Florideæ* and *Coleochæteæ*. Professor Sachs has endeavoured to trace out homologies between the two, which, however, to me appear to be far-fetched and doubtful. It is much easier to suppose that the *Characeæ* is an order standing by itself, than to consider it as allied either to the *Algæ* or the *Musci*. Mr. Bennett has well dealt with this question in the "Journal of Botany," 1878, p. 202; so it will not be necessary to go into any detail here.

As a lineal classification of the *Thallophytes* is impossible, I would tabulate them thus, the orders of the *Algæ* being given in full :—

Class.	Sub-Class.	Orders.			
		Cell Division.	Zoospores.	Oospores.	Zygosperms.
A. Protophyta.	Palmellaceæ. Cyanophyceæ. Schizomycetes.	Palmellaceæ. Cyanophyceæ. Schizomycetes.	Palmellaceæ. Cyanophyceæ.		
B. Algæ.	Conjugatæ.	..	..	..	Desmideæ. Diatomaceæ. Zygnemeæ.
	Cœnobiæ.	..	Hydrodicteæ.	Volvocineæ.	
	Confervoideæ.	Confervaceæ (?).	Confervaceæ. Ulvaceæ.	Sphæropleæ. Œdogonieæ.	
	Cœloblasteæ.	..	Botrydiaceæ.	Siphoneæ.	
	Melanophyceæ.	..	Phæosporeæ.	Fucaceæ.	
	Carposporeæ.	..	..	Coleochæteæ. Florideæ.	
C. Fungi.					

The genealogical tree on Plate Xa. seems to me to show, as nearly as our present knowledge will permit, the genetic affinities of the different orders of the *Algæ*. Of course, much of it is provisional and somewhat doubtful. For example, I have placed the *Palmellaceæ* as the lowest group, but this position may belong

Genealogical Table shewing Relationships of the different Orders of the Algæ.



To illustrate Paper by R. M. Laing.

to the *Chroococaceæ.* Again the *Myxomycetes* are placed in the vegetable kingdom; but there is no more reason for placing them there than in the animal kingdom. The position of the *Conjugateæ*, too, is very doubtful, and it seems not unlikely that the *Zygnemeæ* will have to be separated from the *Diatoms* and *Desmids.* Fertilisation I conceive to have originated in four different orders: the *Fucaceæ*, the *Cænobiæ*, the *Sphæropleæ*, and the *Siphoneæ.* (These are underlined.)

ART. XLIX.—*Observations on the* Fucoideæ *of Banks Peninsula.*

By R. M. LAING, M.A.

[*Read before the Philosophical Institute of Canterbury, 6th August,* 1885.]

Plate X.

THE brown seaweeds must always be an interesting group of plants to the botanist, on account of the exceptional facilities they offer for the investigation of the phenomena of fertilisation and sexual reproduction. The New Zealand genera are especially attractive, because of their great diversity of form and structure.

The first collection of these was made by Mr. Menzies, surgeon to Captain Vancouver's expedition. All his specimens are from Dusky Bay, in the south-west coast of Otago. They were described about the end of the last century. Prior to this time, however, a few marine *Algæ*, common to New Zealand and other southern regions, had been incidentally named by previous visitors to the Australasian seas. Banks and Solander had roughly described one or two of the more conspicuous species. The first systematic collection, however, was made between the years 1821 and 1825, by Bory, one of the naturalists of the French ship *Coquille.* He described about a dozen species of the *Fucoideæ* from various parts of New Zealand. He was followed by Messrs. Lesson and Richard, naturalists of the French ship *Astrolabe.* They contributed three or four new species to the list of those already known. A considerable number of specimens obtained during the second voyage of the *Astrolabe* were described by Montaigne in 1845; and about 1840 a very large collection of New Zealand plants was made by Sir J. Hooker, botanist to the *Erebus* and *Terror* expedition. The *Fucoideæ* obtained by him, to the number of about fifty, were described in "Flora Novæ Zelandiæ."

But by this time a large synonymy had grown up around the nomenclature of the New Zealand seaweeds, partly owing to the same species being described from different coasts under different names, and partly owing to the independent description of collections sent home to English and continental naturalists. Agardh, Turner, Kuetzing, and Lamoureux had all at various times described and named species of seaweeds found in the

southern seas. The confusion that had thus arisen with regard to specific names was much lessened by the appearance of Hooker's "Handbook of the New Zealand Flora" in 1864. The number of brown seaweeds there described is fifty-eight. Almost nothing was done after the publication of this standard work in the way of arranging and classifying the New Zealand *Algæ*, until Dr. Berggren of Lund University made a collection in 1876. His specimens were examined by J. S. Agardh, who published a revised catalogue of New Zealand marine *Algæ*, reducing the number of *Fucoideæ* to fifty-two. Many of the specific names of Hooker were altered, and a few species were united and others cast out. It is, therefore, very difficult for me in many cases to determine the true specific name with certainty, especially as I can only refer to the works of a few of the elder algologists. Therefore, in the following paper, where the name is doubtful I have given it both, as it is in Hooker's Handbook and Agardh's Catalogue. In the "Transactions of the New Zealand Institute" for 1879 there appeared a list of the seaweeds of Canterbury, but as it was evidently only a compilation from Hooker, I will not refer to it further.

The following is a list of the *Fucoideæ* that have as yet been found at Banks Peninsula:—

1. *Ectocarpus siliculosus.* (Lyngbye.)
2. *Sphacelaria paniculata.* (Suhr.)
3. ,, *funicularis.* (Mont.)
4. *Asperococcus sinuosus.* (Bory.)
5. *Zonaria velutina.* (Harvey.)
6. *Desmarestia ligulata.* (Lamoureux.)
7. *Adenocystis lessonii.* (Harvey.)
8. *Ecklonia radiata.* (J. Agardh.)
9. { *Macrocystis dubenii.* (Aresch.)
   ,, *pyrifera.* (Agardh.) }
10. *D'Urvillea utilis.* (Bory.)
11. *Notheia anomala.* (Bailly and Harvey.)
12. { *Hormosira banksii.* (Harv.)
    ,, *labillardieri.* (Mont.) }
13. *Splachnidium rugosum.* (Greville.)
14. *Cystophora scalaris.* (Ag. Mss.)
15. ,, *retroflexa.* (Ag. Sp. Alg.)
16. ,, *dumosa.* (Ag. Mss.)
17. ,, *torulosa.* (Ag. Sp. Alg.)
18. *Fucoidium chondrophyllum.* (Agardh.)
19. *Carpophyllum maschalocarpum.* (Agardh.)
20. *Marginaria boryana.* (Rich.)
21. ,, *urvilleana.* (Rich.)
22. *Sargassum raoulii.* (Harvey.)
23. ,, *sinclairii.* (Harvey.)

OBSERVATIONS.

1. *Ectocarpus siliculosus.*

In Hooker's description of this there is an evident misprint, the length being put down as $\frac{1}{12}$ inch instead of 12 inches.

I have at present no remarks to offer on—

2. *Sphacelaria paniculata.*
3. ,, *funicularis.*
4. *Asperococcus sinuosus.*
5. *Zonaria velutina ;* and
6. *Desmarestia ligulata.*
7. *Adenocystis lessonii.*

Hooker's description is: "Root, a small disk or shield. Frond a dull green or olive-brown, membranous, pyriform sac, on a slender short stalk, hollow or full of water, coated with a thin layer of vertical clavate articulate filaments. Spores pedicelled, pyriform, attached to the base of the filaments and scattered over the whole frond."

Fig. 1 shows a transverse section through the bladder-wall, which consists of two tissues, a narrow epidermal layer of small coloured cells, and an inner layer of oblong colourless cells. From the latter spring long jointed hairs, covering the interior of the bladder and giving it a slightly downy appearance. They are generally colourless, but sometimes contain colouring matter aggregated into more or less rounded masses.

The reproductive organs of this little plant are very interesting, because it seems to possess two kinds of zoogonidia. Thuret ("Ann. de Sc. Nat. Bot.," 1850, p. 235) has described the same occurrence in various other genera of the *Phæosporeæ.* Harvey, ("Phycologica Australica," Pl. xlviii.) says that, in addition to the ordinary fructification on the surface of the bladder, "the frond of *Adenocystis* is dotted with hemispherical gland-like spots, from which lyssoid filaments issue, and which may be possibly connected with antheridia." I have made a large number of sections of these conceptacles (the gland-like spots of Harvey,) without obtaining any very definite results. Fig. 2 shows the most successful of these sections. In it appear two large cells, (Fig. 2, *a.* and *b.*) which perhaps contain zoogonidia. I was not, however, able to determine the position of attachment of these cells.

The conceptacles appear in very young specimens, and consequently I have not been able to ascertain anything about their mode of development; but, judging from the fact that the epidermal tissue passes round the whole conceptacle, it would appear to be the result of invagination alone. Thus it would not be altogether homologous to the conceptacle of the *Fucaceæ,* which,

according to Mr. F. O. Bower, ("Jour. Mic. Sc.," Jan., 1880,) is partly formed by invagination, and partly by deliquescence. In *Adenocystis*, too, these conceptacles are as wide at the mouth as at the base; but in most, if not in all the *Fucaceæ*, the aperture of the fertile conceptacle is much narrower than the interior. The conceptacle of *Adenocystis*, therefore, may be homologous to the "Fasergrübchen" of *Alaria esculenta* and *Fucus platycarpus*. (*Vide* Keutz. "Phycologica Generalis," p. 92.)

When young, the frond of *Adenocystis* is dotted over with tufts of colourless hairs, which encircle the mouths of the conceptacles. A transverse section through the bladder-wall of a not fully matured specimen, shows the frond to be covered with short clavate bodies, in which the cell contents are aggregated together into several distinct masses. It is to these Hooker refers, when he says that "the frond is coated with a thin layer of vertical clavate articulate filaments." A section through the frond of a mature specimen shows it to be covered with three different kinds of bodies:—

(*a*.) A number of short clavate filaments, similar to those already mentioned.

(*b*.) Somewhat longer jointed hairs, probably developed from (*a*).

(*c*.) Oval sacs, containing zoogonidia (?)

These are all represented in fig. 1.

The plant is a common annual, found chiefly in tidal pools. It cannot be obtained during the months of June, July, and August.

8. *Ecklonia radiata.*

The generic description in the "Handbook of New Zealand Flora" is: "Root scutate or dividing into short fibres. Frond olive-green, pinnatifid, ecostate, segments produced from the magnified teeth of a simple lamina, which is contracted to a solid or inflated stem at the base. Sori superficial on the lower part of the pinnæ of narrow ellipsoid spores, mixed with clavate inarticulate filaments." (*Sp. radiata*:) "Frond 1–2 feet long, stem solid or sparingly inflated."

The stem consists of three tissues: an epidermal layer of coloured cells, a second layer of parenchymatous tissue, and a third of loose cells, lying in mucilage. In the second tissue, just beneath the epidermal cells, there is a circular ring of longitudinal "secretion canals," which probably act as conducting or storing vessels for the mucilage; for when a fresh stem is cut through, mucilage exudes from them in considerable quantity. These canals are formed by the splitting away of adjacent cells, and appear first as small irregularly shaped openings in the tissue, some distance from the apex of the frond. As they increase in

size, they are cut off from the surrounding tissue by a ring of small cells. The third tissue consists of anastomosing filaments which have no particular direction with regard to the axis of the plant.

Reproduction by zoogonidia, developed in sporangia,* closely packed together on the lower portions of the frond. The "clavate, inarticulate filaments" of the Handbook are probably young sporangia. I have not as yet been able to see the zoogonidia escape. It is worthy of notice that the sporangia are developed in corresponding patches on both sides of the frond.

Common, just below low water-mark.

9. *Macrocystis dubenii.*

Description in Hooker's "Handbook of New Zealand Flora" (*Generic:*) "Root branching, giving off immensely long, slender, simple stems, which bear leaves at the surface of the water. Leaves formed by the continual splitting of a primary terminal leaf, developed in secund order along the lengthening floating stem, each lanceolate, serrate, ribless, undulate, with a pyriform-oblong or sub-cylindric bladder at its base. Spores superficial on submerged radical leaves, forming clouded sori, ellipsoid with a hyaline coat, surrounded by densely-packed inarticulate paranemata." (*Sp.*) "Stems, 50 to perhaps 700 feet long or upwards. Fronds extremely variable in length and breadth, 2–4 feet long, 2–6 inches broad, ciliate-serrate."

It is wrongly here stated that the stems are simple. They branch dichotomously, but only immediately above the rhizoid. The length of the stem has been variously stated; and it is generally said to be the longest plant in the world. In Lyttelton Harbour, however, it certainly does not attain a greater length than 70 feet; commonly it is from 20 to 30 feet long. In structure the stem is very similar to that of *Ecklonia.* The secretion canals are present, and originate in the stem, at some distance below the apical leaf. In the "Transactions of the New Zealand Institute," vol. xiv., p. 562, it is said: "Professor Parker exhibited and made remarks upon sections of the stem of *Macrocystis*, showing sieve tubes like those of *Cucurbita.*" This doubtless refers to the anastomosing cells of the central tissue, which sometimes closely resemble the sieve tubes of *Cucurbita*, as figured by Sachs.

The bladders are formed by the central tissue ceasing to grow, whilst the external tissues develope rapidly; and, consequently, the stem at this point swells outward, and at last tears apart the filaments of the central tissue, which are left hanging

*I am compelled to use the incorrect term "sporangia," as there is no other English word which can be made to express the idea "mother cells of the zoogonidia."

round the interior of the bladder wall. Fig. 3 is a transverse section through the external tissues of the stem.

Reproduction by zoogonidia, produced in clavate sporangia on the basal leaves. Fig. 4 is a transverse section through a fertile portion of the frond. The sporangia, however, are much more densely crowded together than there represented.

Distribution, everywhere abundant, forming a fringe round the coast; rhizoid fixed below low water-mark.

10. *D'Urvillea utilis.*

Generic description in "Handbook of New Zealand Flora:" "Root scutate. Frond stalked, dark olive-brown or black, flat, expanded, very thick and coriaceous, or honeycombed transversely internally, palmate or pinnate without distinct organs. Fruit diœcious, conceptacles scattered over the whole frond in the cortical stratum, containing either obovoid subsessile spores or branched filaments bearing ovoid antheridia." (*Sp.*) "Frond dark-brown or black, often 30 feet long, forming an immense flabellate palmately-lobed laciniated lamina contracted at the cuneiform base into short stipes as thick as the wrist, segments or thongs often 1 inch thick, honeycombed internally."

The epidermal cells of this plant are much larger than in most brown seaweeds. The central tissue is composed of longitudinal fibres, which occasionally anastomose.

Reproduction: The plant is diœcious. The conceptacles have not a fringe of hairs surrounding the aperture, as in *Fucus platycarpus*, and many other *Fucaceæ*. The reproductive organs may be found almost at any season of the year, but they are best obtained in the winter months. It is stated in Hooker's Handbook (*vide ante*) that the spores (oospheres) are subsessile. This may be the case in young conceptacles; but in the maturer ones the oospheres are developed on branched hairs. Fig. 5 represents one of these branched hairs, bearing several empty and one mature oogonium, with a tripartite oosphere. This is an important exception to the rule that unbranched hairs alone are found in the female conceptacles. Fig. 5, *a*, *b*, *c*, show the method of division of the oosphere.

At low tide, on a warm moist winter's day, many of the fronds of *D'Urvillea*, if examined, are seen to be covered with hundreds of little dark-brown almost black papillæ, consisting solely of oospheres expelled from the conceptacle. The antheridia do not collect outside the conceptacle in such numbers as the oospheres, but they occasionally form whitish dots covering the surface of the frond. The antheridia are developed in the usual way on branched hairs.

Hab. Common about low tide-mark, on exposed rocks.

11. *Notheia anomala.*

Description in Hooker's Handbook (*generic*): "Frond, olive-

green, parasitic, filiform, irregularly branched, proliferous, solid, with distinct stem and branches, but no bladders or leaves. Conceptacles scattered over the whole frond under the surface, containing linear-obovate spores, and simple paranemata." (*Specific:*) "Fronds 3–8 inches long, growing from the conceptacles of *Hormosira*, excessively branched, bushy, cylindric; branchlets narrow, spindle-shaped, axis of solid interwoven filaments, periphery of radiating coloured filaments."

This is undoubtedly a true parasite, as it is never found elsewhere than on *Hormosira banksii.* It generally grows out of one of the conceptacles of its host, but occasionally out of the solid portion of the stem, when it never penetrates deeper than the cortical tissue. True parasitism is very rare among the *Fucoideæ.* One or two cases in the *Phæosporeæ* are mentioned by Decaisne and Le Maout. This is the only one with which I am acquainted amongst the *Fucaceæ.*

Reproduction: The plant is diœcious. I have not seen the male conceptacles; and here it may be noticed that, in all the New Zealand *Fucaceæ*, female specimens are very much more plentiful than the male. The female conceptacle contains unbranched hairs; but there are no long hairs surrounding the aperture of the conceptacle. The oogonia are developed in the ordinary way; but the number of oospheres in each oogonium appears to vary from about 7 to 11; but, as I have had no opportunity of examining fresh specimens of this plant, I am not quite sure about this point. Fig. 6 shows several oogonia.

Hab. In tidal pools, on *Hormosira*; not uncommon, to some extent sporadic.

12. *Hormosira banksii.*

This has been fully described by Mr. Mollet. ("Trans. N.Z. Inst.," 1880, Art. xxxix.)

13. *Splachnidium rugosum.*

Description in Hooker's Handbook (*Generic:*) "Root, a disk. Frond olive-green, cylindric, proliferously branched; branches saccate, full of mucilage and branched filaments; walls thin, membranous. Fruit diœcious. Conceptacles scattered over the whole surface of the frond, attached to the inner surface of its walls, spores linear-oblong, subsessile, paranemata simple." (*Specific:*) "Fronds, 4–8 inches high. Main axis stout, cylindric or club-shaped; $\frac{3}{4}$ inch in diameter; branches sac-like, truncate, 1–2 inches long, surface covered with mamillæ, each furnished with a pore that opens into the spore cavity beneath."

The stem consists of an epidermal tissue of small coloured cells surrounding a mass of mucilage, into which protrude a number of long branched hairs. The top of the growing stem is covered with a slight down, composed of very peculiarly-shaped colourless hairs, made up of a number of cells which are

converse on one side and nearly straight on the other. These cells are sometimes filled with granular matter, which may be forced out by a slight pressure. As the antheridia of the plant have never been observed, it is just possible that these hairs may be antheridial in function.

Reproduction: Plant diœcious. The conceptacle is surmounted by a ring of hairs, and in its interior contains a number of unbranched hairs. The oogonia are obscurely pedicelled, and developed on the cells lining the wall of the cavity. Each oogonium gives rise to a large number of oospheres, thus differing from all other *Fucaceæ* that have hitherto been described. Each oosphere is very small, compared with the oospheres of any of the other *Fucaceæ*. Fig. 7 shows several oogonia.

Hab. An annual, common on tidal rocks.

14. *Cystophora.*

I have no remarks to offer upon this genus.

19. *Carpophyllum maschalocarpum.*

In this plant I have noticed antheridia developed from the surface cells of the conceptacles. Mr. F. O. Bower has noted the same in another genus of *Fucaceæ.*

20. *Marginaria boryana; M. urvilleana.*

Hooker's description is (*Generic*): "Frond olive-green, unilaterally, flabellately pinnate. Leaves, bladders, and receptacles distinct. Leaves sub-confluent with the stem, dichotomously semi-flabellate, vertical. Bladders in series, on the upper margins of the leaves. Receptacles in series with the bladders, unilateral, sub-simple, terete or compressed, containing spherical conceptacles with obovoid spores." (*Sp. boryana:*) "Frond many feet long, naked below; pinnæ linear, very long, $\frac{1}{6}-\frac{1}{4}$ inch broad, ribless with hooked serratures. Bladders elliptic-obovoid, as large as a hazel nut, sub-apiculate. Receptacles cylindric, 1 inch long, acuminate, simple or sparingly spinous. (*Sp. urvilleana:*) A smaller plant than *boryana*, but hardly distinct specifically; the pinnæ are a foot long, gradually dilated, simple or flabellately branched on one side. Bladders smaller, sub-spherical, not apiculate."

I have only seen a few specimens of this genus; but since the two species as figured by Montaigne in the "Voy. au Pole Sud" are evidently male and female plants of a single species, there is probably only one species, subject to a few slight variations.

The stem consists of three tissues, but presents no peculiarities.

Reproduction: Plant diœcious. I have only seen female conceptacles, which are of the ordinary typical form. It is

worthy of notice, however, that the development of the conceptacle in this plant might easily be worked out. A single plant furnishes receptacles with conceptacles at all stages of growth. The oogonium originates as a papillose swelling on one of the parietal cells of the conceptacle, is segmented off, and gradually developes into the mature form. The hairs are developed long before there is any sign of the oogonia, and the conceptacles themselves commence as an invagination of the cortical tissue. Fig. 8 shows a transverse section through a young conceptacle.

Hab. Rare, only met with in fragments cast up upon the shore; probably deep sea.

22. *Sargassum.* I have no remarks to offer upon this genus.

EXPLANATION OF PLATE X.

Fig. 1. Transverse section through bladder-wall of *Adenocystis lessonii*, showing reproductive organs, and hairs on the surface of the frond. (× 140.)
2. Section through conceptacle of *Adenocystis lessonii; a.* and *b.*, cells containing zoogonidia (?) (× 140.)
3. Transverse section through external tissues of stem of *Macrocystis dubenii; a., b., c.*, secretion canals (× 200.)
4. Transverse section through fertile portion of the frond of the same. (× 250.)
5. Branched hairs of *D'Urvillea*, bearing oogonia. (× 140.)
6. Section through portion of conceptacle of *Notheia anomala.*
7. Section through portion of conceptacle of *Splachnidium rugosum.*
8. Section of conceptacle of *Marginaria urvilleana*, showing young conceptacles. (× 45.)

ART. L.—*On the Growth of Transplanted Trees.*

By J. BABER, C.E.

[*Read before the Auckland Institute, 29th June, 1885.*]

IN Vol. V. of "Proceedings of New Zealand Institute," fol. 451, will be found a table of the growth of Native trees during 20 years. A continuation of this record may probably be of use at some future time to those engaged in forestry.

The table (1885) attached refers to the same native trees which were the subject of the table of 1872, leaving out those which were merely ornamental. Measurements have been confined to puriri, pohutukawa, titoki, tanekaha, and warengapiro. The sizes of some other trees are added, with their age and the name of planter; many interesting trees at Bird Grove, Epsom, and in St. George's Bay, in plantations made in the early times, have been omitted, as evidence of date cannot be obtained.

As regards kauri, it is to be regretted that the information is scanty, occasioned by the paucity of transplanted trees. Success in raising and planting kauri is difficult.

Some years ago, Dr. Carl Fischer raised kauri seedlings in a very clever way. Bamboo canes from fruit cases were cut in lengths of 5 or 6 inches, placed upright in a boarded case, and filled with earth. The seed sown in them germinated well. There was no difficulty in transplanting, as bamboo and seedling could be put into the ground together. What became of these seedlings I never learnt. The trees in the Government Domain, planted by Mr. Chalmers, domain-keeper, show by their growth that the kauri may be classed amongst profitable trees. Puriri comes next; the demand for this timber is every year increasing, also its value. Comparison between the tables of 1872 and 1885 shows that, although the trees increased slowly in height after 20 years, the succeeding 13 years have added a good deal to their bulk. The value given is estimated at the present price of fencing-posts and house-blocks.

Puriri when young is subject to be killed by frost. It thrives best on hill sides, and the more surrounded by other trees the better. When planted the stem should be cut off 6 inches above the ground; two or three shoots will result, and grow straight up. When fit for poles one or more can be cut, leaving the best for timber. I have examined a great many transplanted puriris and have not found any appearance of makaroa, the worm which bores the tree in its native forest.

I place pohutukawa next in value. No tree is easier raised; hundreds of plants can be obtained from sandstone cliffs, and nine out of ten will grow. Its rate of growth is rather slower than that of puriri, as also its rate of bulk increase. When thoroughly dried it is a durable wood, and in withstanding concussion I think it is superior either to puriri or oak.

Totara is now being taken care of by settlers, as it comes up in many places spontaneously. My record goes back only 20 years, too short a period to form an opinion.

Tanekaha, in many places, is being ruthlessly destroyed for the sake of its bark. For this reason it may be a valuable tree.

Titoki will serve to fill up a plantation; its slow growth will perhaps be compensated by its usefulness in the manufacture of tool-handles, etc. Warengapiro, a cabinetmaker's scented wood, will serve also to fill up. Its growth is very slow; its foliage never yields to the strongest gale. The demand for this wood will increase.

Of matai, towhai, and mairi, particulars are not given.

Of our English trees, oak claims precedence. The oaks in the Government House grounds are the oldest in the Provincial District. The acorns were sent from Sydney, and sown by Mr. Cleghorn, Superintendent of Public Works, in the Government Gardens in 1841 or 1842. The seedlings were planted out in 1844 or 1845, so that these trees are 40 years old. Beautiful as they are, these trees have been neglected for timber purposes;

most of them have trunks not exceeding 7 feet in length, fit only for coopers' staves or firewood. An observer will, however, notice that where the trees were thickly planted, there the butts are longer, and give hope of timber.

Excepting a few easily found, the oaks in the Domain were planted by Mr. Chalmers, domain-keeper, 22 years ago. These 22-year-old trees are equal in height to those in the Government House grounds of 40 years, and have barrels varying from 18 to 25 feet in length; and if attended to, which, I regret to say, is not the case, these trees promise valuable timber. A few years since the Press threw a deal of small ridicule on an old colonist, then a member of the Domain Board, and invented the term "Mitfordise." Time, however, proves that Mr. Mitford was right, and planters will do well to follow his system of trimming off lower branches, so as to produce straight trunks. The best mode of raising oaks is to sow acorns five or six in a place, thin out, and leave one to grow.

The elm flourishes in gullies or low sheltered lands. It is a greedy feeder, and (as will be seen in the table) attains a height of 50 feet in 33 years. When more extensively grown, it will supply a substitute for puriri for railway sleepers. Good examples of wych elms can be seen at Mr. Westwood's, Remuera, planted for shelter and ornament. Their timber capability has been neglected.

Of pines, I have selected two only, the Maritina and Stone pine, which yield good timber; that of the Insignis, so much planted for its beauty and quick growth, is useless, save for firewood. These, sparingly mixed, should form part of every plantation. Some beautiful Stone pines, well trimmed and attended, will be found at Mr. Dilworth's, Remuera, but I am not able to give their age.

The table of 1885 includes two kinds of fruit-bearing yet forest trees, well deserving attention, the walnut and the olive.

The oldest walnut tree in or near Auckland is at Mr. T. Osborne's, Manukau Road, Newmarket. It came from Hobarton in 1842, was planted by the Rev. Walter Laury's tenant, and has been cared for by Mr. Osborne for the last 38 or 39 years. From this tree, and from five others raised from its nuts, Mr. Osborne derives a revenue of £20 a year, £3 6s. 8d. a tree; the estimated value of the tree will be £5. The walnut bears fruit eight years after sowing the nut. If proper care be taken, its butt will rise to 12 feet, a handsome tree, producing a yearly crop, and its timber valuable in the market of the world. The walnut will not flourish on retentive soils, but grows freely on volcanic land, and probably on stony land.

The Olive. The oldest examples of this tree are to be found at Brookside, Parnell, planted by the late Colonel Matson about the year 1848. Growing on sloping ground on a clay soil, these

trees have attained a height of 20 feet, and bear a crop, which is every year consumed by imported birds. These trees will be of value to the owner, as they will afford cuttings and grafts of *O. olivo-vero*, whenever proprietors of land near the sea coast have the good sense to plant this valuable tree. I think it was in 1883 that the Government imported a number of olive eyes and grafts, not knowing that the tree was flourishing here.

This paper refers only to the trees of the North part of this Island. As regards the quantity of timber remaining in the two Islands, it is probable that the next generation will not feel much want of supply; but, with demand and consumption increasing every year, it is plain that 30 or 40 years hence timber will be of great value.

"Let posterity take care of itself" is an adage often used, but it must not be the creed of him who plants forest trees.

Table of the Rate of Growth of Transplanted Trees.

Name of Tree.	Height in feet.	Circumference 2 feet above the ground.	Age.	Situation.	Value.	Planter.
		ft. in.	Years.		£ s. d.	
Puriri	28	4 4	38	Remuera ..	0 9 0	J. B.
Pohutukawa ..	22	2 0	33	" ..	0 2 6	
Titoki	18	1 9	33	" ..	..	J. B.
Totara	18	1 6	20	" ..	0 1 6	J. B.
Warengapiro ..	11	..	33	" ..	..	J. B.
Kauri	20	1 8	16	Domain ..	..	Chalmers.
Oak	32	3 0	40	Gov. House Grounds	0 3 0	Cleghorn.
Do.	32	2 0	22	Domain ..	0 1 6	Chalmers.
Elm	50	3 9	33	Remuera ..	0 3 0	J. B.
Stone pine ..	41	6 0	35	Epsom ..	..	Capt. Powditch.
Maritina pine	32	3 6	25	Remuera ..	..	J. B.
Walnut.. ..	20	5 0	43	Epsom ..	5 0 0	Rev. W. Laury's tenant.
Do.	19	5 0	30	" ..	5 0 0	J. Osborne.
Olive	20	..	36	Parnell ..	..	Col. Matson.

Estimated Produce of Plantations at end of Fifty Years, planted with 1,000 Trees of 10 different sorts, per acre:—

				£ s. d.
First thinning	10 years	300	..	..
Second "	20 "	300 @ 1/6	..	22 10 0
Third "	30 "	300 @ 2/6	..	37 10 0
Leaving at	50 "	100, worth 10/		50 0 0
				£110 0 0

ART. LI.—*Description of three New Species of* Coprosma.

By T. F. CHEESEMAN, F.L.S.

[*Read before the Auckland Institute, 30th November*, 1885.]

1. *Coprosma tenuifolia*, n. sp.

A RATHER slender, sparingly branched shrub or small tree, 8–15 feet high, glabrous, with the exception of a line of hairs on the midrib and petiole; branches slender, terete, bark pale. Leaves membranous, $1\frac{1}{2}$–5 inches long, $\frac{1}{2}$–$1\frac{1}{2}$ inch broad, varying from ovate or oblong-ovate to oblong-lanceolate or elliptic-lanceolate, acute or acuminate, narrowed into rather long and slender petioles, $\frac{1}{4}-\frac{3}{4}$ inch long, dull brownish-green above, paler below; veins conspicuous on both surfaces, very finely reticulated. Stipules rather large, triangular, connate at the base, thin, often ciliate at the margins or apex when young. Flowers not seen. Fruit in dense fascicles of 3 to 8 on short lateral branchlets, $\frac{1}{4}-\frac{1}{3}$ inch long, ovoid or oblong.

Hab. Ruahine Mountains; *Colenso* ("Handbook," p. 114). Pirongia Mountain; Mount Karioi; abundant on the Mount Egmont Ranges; *T.F.C.* I have also seen specimens collected by Mr. Kirk between Upper Wanganui and the Waikato, so that probably it has a wide distribution in the interior of the North Island.

I have been acquainted with this species for many years, but have delayed describing it, in the hope of obtaining flowering specimens. It was first gathered by Mr. Colenso on the Ruahine Mountains, and is the plant alluded to in the Handbook in a note to the description of *C. acutifolia.* I have never seen *C. acutifolia*, but Mr. N. E. Brown, of the Kew Herbarium, who has done me the favour of comparing the type specimens of that species with my plant, informs me that the two are certainly distinct; and in this opinion Sir Joseph Hooker also concurs.

The dull-green membranous foliage of *C. tenuifolia* approaches that of *C. grandifolia*, and the habit is also not much dissimilar. The fruit, however, proves that the inflorescence is totally different. From *C. lucida*, *C. robusta*, etc., it is at once separated by the membranous leaves.

2. *Coprosma areolata*, n. sp.

An erect, closely branched shrub or small tree, 6–15 feet high, or even more. Branches slender, often fastigiate, bark pale-greyish-green or brown; ultimate pubescent or almost villous, with soft greyish hairs. Leaves in opposite pairs, $\frac{1}{3}-\frac{2}{3}$ inch long, orbicular-spathulate, ovate-spathulate, or elliptic-spathulate, usually acute or apiculate, but sometimes obtuse, rather thin and membranous, flat, glabrous or nearly so above, usually

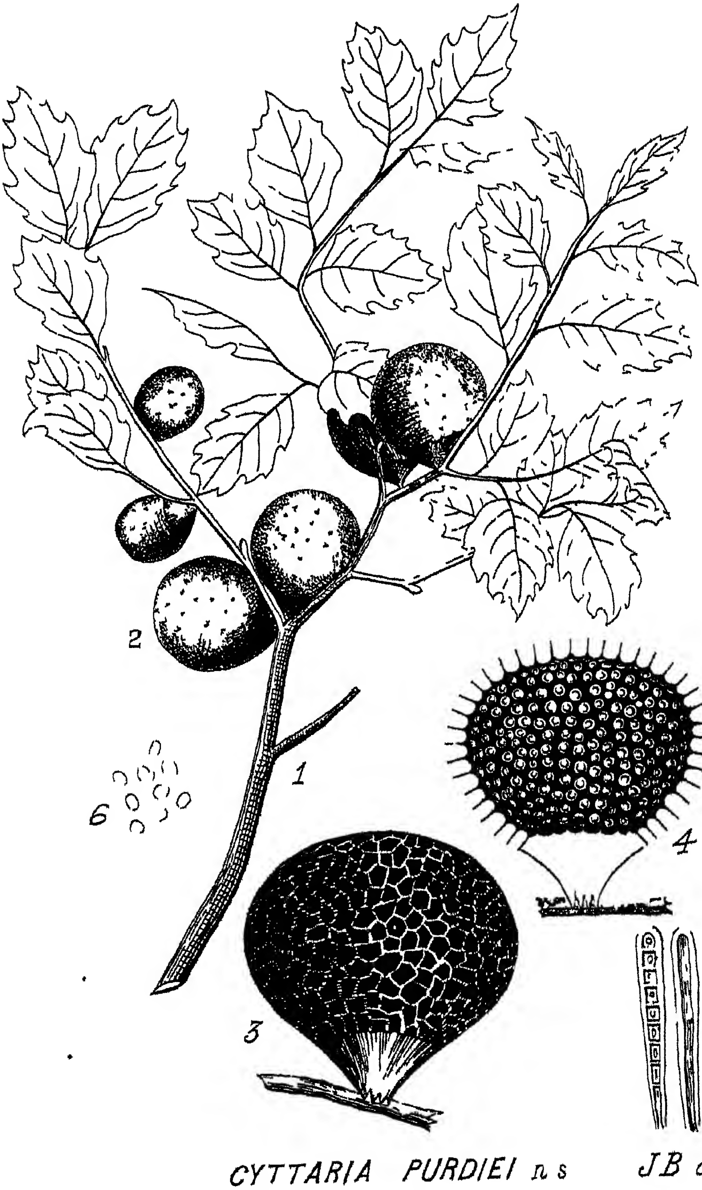
pubescent on the veins below, suddenly narrowed into short hairy petioles; veins reticulated in large areoles. Stipules triangular, pubescent. Flowers axillary, solitary or more usually in few flowered fascicles. *Males:* usually two to four together, small, $\frac{1}{8}$–$\frac{1}{6}$ inch long. True calyx wanting, but its place is supplied by one or two involucels composed of a pair of depauperated leaves and their stipules, and which closely invest the base of the corolla. Corolla broadly campanulate, divided about half-way down into four or five lobes. Stamens 4–5; anthers large, pendulous. *Females:* solitary or two together, rarely more, $\frac{1}{10}$–$\frac{1}{8}$ inch long. Calyx limb minute, truncate or very obscurely 4-lobed, closely invested by an involucel similar to that of the male flower. Corolla narrow and tubular at the base, divided about two-thirds of the way down into three or four divisions, lobes often spreading. Drupe small, oblong or obovoid, $\frac{1}{6}$ inch long.

Hab. North Island: common in Auckland province, and probably in most lowland districts. South Island: Nelson, *T.F.C.*; Otago, *D. Petrie.*

A very distinct species, quite different in habit to any of its allies. It forms a compact densely-branched shrub or small tree, usually narrow for its height, and often quite fastigiate. The slender, soft and pubescent branchlets, pale bark and foliage, and the reticulated veins of the leaves, are prominent characters. It is a familiar plant to New Zealand botanists, but has not been previously described. In the "Handbook," as Mr. N. E. Brown informs me, it was confused with *C. rotundifolia.* But that species has wide-spreading branches, larger leaves, more numerous flowers, and a smaller globose or didymous drupe. It is much nearer to *C. tenuicaulis*, but that also differs in its more spreading habit, dark coloured bark, more glabrous leaves and branchlets, smaller, rounder, more coriaceous leaves, and in the globose drupe.

3. *Coprosma petriei*, n. sp.

A small alpine species, with prostrate and creeping stems. Branches long or short, 6–18 inches, usually densely matted, creeping and rooting, glabrous or puberulous. Leaves close set or distant, erecto-patent, coriaceous, $\frac{1}{10}$–$\frac{1}{4}$ inch long, linear-oblong or linear-obovate, acute or obtuse, gradually narrowed into very short broad petioles or sessile, veinless, glabrous or margins, or both surfaces with short white hairs. Stipules rather long, puberulous and ciliate. Flowers solitary, terminating short erect branchlets. *Males:* $\frac{1}{8}$–$\frac{1}{10}$ inch long. True calyx wanting, but in its place a series of from 1–3 involucels composed of depauperated leaves and their stipules. Carolla tubular at the base, above broad and campanulate, 4-lobed. Filaments very long. *Females:* Minute, hardly



CYTTARIA PURDIEI n s J B del.

$\frac{1}{10}$ inch long, invested at the base with involucels similar to those of the males. Calyx limb irregularly 4–5 toothed. Corolla short, broadly tubular, 4-lobed to below the middle. Styles, 2. Drupe globose, $\frac{1}{6}$ inch diameter, blueish.

Hab. South Island, mountains near Lake Tekapo, Canterbury, altitude 4,000 feet; *T.F.C.* Uplands in the interior of Otago, common; *D. Petrie!*

Mr. Petrie and myself had placed this, with some doubt, under *C. repens.* But Sir Joseph Hooker and Mr. N. E. Brown agree in considering it quite distinct from both *C. repens* and *C. pumila.* The infundibuliform corolla of the male flowers is certainly very distinct from the curved tubular one of *C. repens.*

ART. LII.—*On* Cyttaria Purdiei, *Buch.*

By JOHN BUCHANAN, F.L.S.

[*Read before the Wellington Philosophical Society, 24th February*, 1886.]

PLATE XI.

THE present interesting ephiphytic fungus, although probably abundant in New Zealand, has not hitherto been noticed as occurring there in any scientific work. The genus *Cyttaria*, to which it belongs, is supposed to be limited in distribution to South America and Tasmania, where two species are known and used as food. They are always found epiphytic on species of *Fagus* or beech, and will probably be found wherever this family is abundant.

The internal cavity of this fungus has always been found empty; yet it is probable that in the earlier stages of the plant it may be filled with a gelatinous fluid, which is afterwards absorbed or dried up. This can only be proved by an examination of numerous specimens in different stages of growth.

REFERENCE TO PLATE.

Fig. 1. Branch of *Fagus fusca* with plants of *Cyttaria purdiei* adhering.
2. Young plants of *Cyttaria purdiei*, with the spore cups or cells still covered by a thin membrane.
3. Plant with the spore cups or cells divested of their membranous covering and empty.
4. Section of plant, showing the empty cells with rounded bottoms, and the interior of the fungus empty.
5. Asci with sporidia.
6. Spores.

Art. LIII.—*Additional Contributions to the Flora of the Nelson Provincial District.*

By T. Kirk, F.L.S.

[*Read before the Wellington Philosophical Society, 24th February*, 1886.]

In the fourteenth volume of the Transactions, Mr. Cheeseman has given a valuable catalogue of plants observed by him in the Provincial District of Nelson. I now venture to supplement his list with an enumeration of the species collected during my hasty visits to different parts of the district, and which do not appear to have come under his notice. I have added a few species, of which specimens have been given to me by Mr. P. Lawson, who resided in Nelson for two years; the Rev. F. H. Spencer, now of Reefton; and Mr. D. Grant, of Nelson: the authority being stated in each case. A few localities are stated for such plants as *Mimulus repens, Epacris pauciflora, Lomaria fraseri*, etc., etc., inserted by Mr. Cheeseman on the authority of the "Handbook of the New Zealand Flora," but not actually observed by him.

Although the plants now catalogued form a material addition to the previous record, the chief interest lies in the importance of certain species from the phyti-geographical point of view: *e.g., Actinotus bellidioides, Liparophyllum gunnii, Metrosideros robusta, M. tomentosa, Schœnus nitens, Cladium teretifolium, Euphrasia disperma, Trichomanes humile*, etc., etc.; but our knowlege of the Flora of the district must be made more complete before we are able to appreciate their correct significance.

Ranunculaceæ.

Clematis afoliata, J. Buch. Hanmer Plains; Wai-au-ua River.

Ranunculus subscaposus, Hook. f. Two forms of this plant are not uncommon by the Stanley River, and in other parts of the Amuri:—

α. Erect, leaves on long petioles, excessively silky, peduncles stout, much shorter than the leaves.

β. Much branched, sub-fluilant, hairy or almost glabrous; petioles short.

Cruciferæ.

Lepidium oleraceum, Forst. The Arrow Rock, *H. B. Kirk!*

Pittosporeæ.

Pittosporum patulum, Hook. f. Spencer Mountains.

Hypericineæ.

Hypericum gramineum, Forst. Nelson.

MALVACEÆ.

Hoheria populnea, A. Cunn.; *β. lanceolata.* Takaka Valley, etc.
Hibiscus trionium, L. South Wanganui, Lyell ("Handbook"); near Collingwood.

TILIACEÆ.

Aristotelia colensoi, Hook. f. Rotoiti; Lyell, etc.
Elæocarpus dentatus, Vahl. Near Westport; Takaka Valley, etc., etc.

ANACARDIACEÆ.

Corynocarpus lævigata, Forst. A single specimen grows near Karamea, *J. H. Jennings;* also reported to occur in the vicinity of Collingwood.

CORIARIEÆ.

Coriaria angustissima, Hook. f. Spencer Mountains.

LEGUMINOSÆ.

Carmichælia grandiflora, Hook. f. Lyell, and other places in the Valley of the Buller.
Swainsonia novæ-zealandiæ, Hook. f. Above Fowler's Pass; Spencer Mountains.

ROSACEÆ.

Geum uniflorum, J. Buch. Spencer Mountains.

HALORAGEÆ.

Myriophyllum pedunculatum, Hook. f. Near Cape Farewell.
Gunnera densiflora, Hook f. Descends to the sea level at Cape Farewell Spit.
,, *prorepens*, Hook. f. Mokihinui.

MRYTACEÆ.

Metrosideros parkinsonii, J. Buch. Aorere Valley.
,, *robusta*, A. Cunn. From Greymouth northwards to Cape Farewell, common; Collingwood; Aorere Valley; Takaka and Riwaka Valleys, etc.
,, *tomentosa*, A. Cunn.

Mr. Macallister, of the Telegraph Department, informed me that this species was plentiful on the cliffs between Riwaka and Waitapu, where it occurred in sufficient quantity to furnish the framework of a small vessel built there a few years ago. I was also assured by a surveyor that one or two trees were still standing on a point between Takaka mud-flats and Collingwood. At a point nearer Collingwood I found several stunted plants from 1 to 2 feet high on the face of a cliff; but as the leaves had not assumed the tomentose condition characteristic of the mature state of this species, I hesitate to pronounce them identical, although their leaves are broader than those of *M. robusta*, the only species which could be mistaken for it.

Mr. Macallister was so well acquainted with the pohutukawa in Auckland, that it is not probable he is mistaken in the identification. At the same time, its occurrence in the South Island is so unexpected that it is most desirable to obtain specimens of the Waitapu plant in the mature state.

Myrtus bullata, Banks and Sol. In one place near the Dun Mountain track; also by the road to the copper mine; *Mr. Buckeridge.*

I did not see this plant in the Nelson district, but Mr. Buckeridge, of the Survey Department, who was my travelling companion through the Rai Valley, where it is plentiful, informed me that he had observed it in the localities mentioned above. It is common about Picton, and in other localities in Marlborough.

M. ralphii, *M. obcordata*, and *M. pedunculata*, were observed by Dr. Boor and myself growing in close proximity in one of the lateral valleys of the Maitai, in 1878, but we searched in vain for *M. bullata.*

Onagrarieæ.

Epilobium confertifolium, Hook. f.; *β. tenuipes.* Spenser Mountains.

,, *alsinoides*, A. Cunn. Abundant in many parts of the district.

Umbelliferæ.

Hydrocotyle americana, Arn. Mokihinui, etc.

,, *asiatica*, L. Aorere Valley, etc.

,, *muscosa*, Br. Lake Guyon.

,, *pterocarpa*, F. Müeller. Mokihinui.

Pozoa haastii. Hook. f. Spenser Mountains.

Ligusticum haastii, F. Müell. Spenser Mountains.

Angelica decipiens, Hook. f. Mount Captain Range, Amuri.

Actinotus bellidioides, Beush. Var. *novæ-zelandiæ.* Mount Rochfort, *Rev. F. D. Spenser.*

Rubiaceæ.

Coprosma pumila, Hook. f. Between Fowler's Pass and Lake Guyon, etc., etc.

Mr. Cheeseman states that he can find no distinguishing characters between this species and *C. repens*, and believes both to be forms of the same plant.

I am unable to accept this view, on account of the wide difference between the fruits of the two species, independently of other characters. The fruit of *C. pumila* is spherical, slightly depressed, crimson, small; while that of *C. repens* is ovoid, purple, translucent, the largest of the genus. At elevations of 3,000 feet and upwards, *C. pumila* becomes nearly herbaceous; but *C. repens* invariably retains its ligneous habit, even at the extreme altitude of 4,500 feet.

In "Handbook of the N.Z. Flora" the fruit of *C. pumila* is described as that of *C. repens* also.

COMPOSITÆ.

Cotula australis, Hook. f. Wakapuaka, etc., etc.
Senecio sciadophilus, Raoul. Nelson; *Rev. F. H. Spencer!*

STYLIDICÆ.

Forstera bidwillii, Hook. f. Rotoiti.
Phyllachne clavigera, Beush. and Hook. f. Spenser Mountains.

ERICEÆ.

Epacris pauciflora, A. Rich. 'Aorere Valley; Takaka Valley; common about Waimangaroa, Westport, etc.
Dracophyllum latifolium, A. Cunn. Riwaka Valley; Takaka Valley; Aorere Valley; Waimangaroa.

JASMINEÆ.

Olea lanceolata, Hook. f. Wairoa.

GENTIANEÆ.

Liparophyllum gunnii, Hook. f. Mount Rochfort; *Dr. Gaze.*

CONVOLVULACEÆ.

Cuscuta densiflora, Hook. f. Nelson; *P. Lawson.*
,, sp. nov. Ahaura Plains.

SCROPHULARIEÆ.

Mimulus repens, Br. Muddy places in Nelson Harbour; occurring in great abundance during certain seasons, but often extremely rare.
Gratiola nana, Beush. Rotoiti, 1875.
Veronica macroura, Hook. f. Tarndale; "Handbook N.Z. Fl."
,, *diosmæfolia*, R. Cunn. A plant, of which I found specimens in the Maitai Valley, but in an imperfect condition, is doubtfully referred to this for the present.
,, *canterburiense*, J. B. Armstrong. Rotoiti, etc.
Pygmæa ciliolata, Hook. f. Amuri.
Euphrasia cuneata, Forst. Aorere River.
,, *disperma*, Hook. f. Mount Rochfort, *Rev. F. H. Spencer;* Ahaura Plains, *T.K.*

LENTIBULARIEÆ.

Utricularia monanthos, Hook. f. Lake Guyon.

CHENOPODIEÆ.

Rhagodia nutans, Br. The Brothers; near Westport, *Dr. Gaze.*
Chenopodium urbicum, L. Amuri; Hanmer Plains.
,, *pusillum*, Hook. f. Nelson, *Professor F. W. Hutton!*
Atriplex cinerea, Poir. Nelson, *P. Lawson!*

PROTEACEÆ.

Knightia excelsa, Br. Croixelles Harbour.

THYMELEÆ.

Pimelea traversii, Hook. f. Amuri.
,, *arenaria*, A. Cunn. Cape Farewell.

LORANTHACEÆ.

Loranthus micranthus, Hook. f. Waimangaroa; Mokihinui, etc.

EUPHORBIACEÆ.

Euphorbia glauca, Forst. Cape Farewell, etc.

CUPULIFERÆ.

Fagus blairii, T. Kirk. Valley of the Little Grey River.

CONIFERÆ.

Podocarpus acutifolius, T. Kirk. Hope Valley; Rotoiti, etc.
Dacrydium westlandicum, T. Kirk. Aorere Valley, and other places on the West Coast as far South as Greymouth.

ORCHIDEÆ.

Earina autumnalis, Hook. Lower part of the Valley of the Buller.
Dendrobium cunninghamii, Linde. Aorere Valley; Mokihinui; Westport.
Bolbophyllum exiguum, F. Müell. Collingwood; "Trans. N.Z. Inst.," vol. xvi., p. 397.
Acianthus sinclairii, Hook. f. Nelson, *H. B. Kirk!*
Adenochilus gracilis, Hook. f. Nelson, *P. Lawson*, 1869.
Caladenia minor, Hook. f. Port Hills, Nelson, etc.
Pterostylis micromega, Hook. f. Lake Guyon.
Prasophyllum nudum, Hook. f. Dun Mountain, *H. H. Travers!* in Colonial Museum.
Calochilus paludosus, Br. Collingwood; "Trans. N.Z. Inst.," vol. xvi., p. 397.

NAIADEÆ.

Potamogeton oblongus, Vir. Takaka Valley; Aorere Valley; Mokihinui.
Zostera nana, Rosh. Takaka mud-flats.

LILIACEÆ.

Astelia cunninghamii, Hook. f. On the western side of the district from Collingwood to Charleston, but somewhat local.
,, *grandis*, Hook. f. Lowland swamps on the West Coast.
,, *solandri*, A. Cunn. Not uncommon on the West Coast.
,, *trinervia*, T. Kirk. Between Wakapuaka and the Rai Valley.
Arthropodium cirrhatum, Br. West Wanganui, *Mr. R. Hurst-house*, M.H.R.!

JUNCEÆ.

Juncus brevifolius, T. Kirk. Rotoiti.
,, *involucratus*, T. Kirk, Amuri.

RESTIACEÆ.

Centrolepis monogyna, Beush. Mount Rochfort, *Rev. F. H. Spencer.*

CYPERACEÆ.

Schœnus axillaris, Hook. f. Aorere Valley, etc.
,, *tenax*, Hook. f. Aorere Valley.
,, *tendo*, Hook. f. Aorere Valley.
,, *nitens*, Hook. f. Cape Farewell Spit.
Eleocharis sphacelata, Br. Takaka Valley.
,, *acuta*, Br.; var. *platylepis*. Motueka; Aorere Valley; and other places; common.
,, *gracillima*, Hook. f. Aorere Valley.
Isolepis inundatus, Br. Aorere Valley, etc.
Cladium glomeratum, Br. Takaka Valley; Aorere Valley; West Coast.
,, *teretifolium*, Br. Aorere Valley.
,, *gunnii*, Br. Aorere Valley; West Coast.
Gahnia rigida, T. Kirk. Aorere Valley; Ngakawau.
Oreobolus filiformis, Bergg. Mount Rochfort.
Uncinia ferruginea, Booth. Ngakawau; Mokihinui; Westport.
Carex viridis, Petrie. Valley of the Stanley, Amuri.

GRAMINEÆ.

Stipa micrantha, Car. Upper part of the Takaka Valley, *Rev. F. H. Spencer!*

Apera arundinacea, Hook. f. Nelson.

Sporobolus indicus, R. Br. A few tufts on the Port Hills, Nelson, 1878, *Capt. D. Rough* and *T. Kirk.*

Agrostis pilosa, A. Rich. Abundant in the Amuri.

Phragmites communis, Fries. Valley of the Little Grey, *Dr. von Haast.*

Catabrosa antarctica, Hook. f. Mount Arthur, *J. Buchanan*; "Indigenous Grasses of N.Z."

Poa lindsayi, Hook. f. Amuri.

,, *pusilla*, Bergg. Amuri.

,, "*intermedia*," J. Buch. Rotoiti.

,, *sclerophylla*, Bergg. Mount Captain Range.

,, "*uniflora*," J. Buch. Mount Arthur; "Indigenous Grasses of N.Z."

Bromus arenarius, Lab. Cape Farewell.

Filices.

Gleichenia circinata, Swartz. Aorere Valley, and West Coast.
,, *cunninghamii*, Heward. Aorere Valley, and West Coast to Greymouth.
Cyathea cunninghamii, Hook. f. Bateman's Gully, *D. Grant!*
Hymenophyllum cheesemanii, Baker. Mokihinui.
Trichomanes elongatum, A. Cunn. Collingwood, *D. Grant!*
,, *humile*, Forst. Happy Valley, Nelson, *D. Grant!*
Lindsaya linearis, Sw. The Port Hills, *D. Grant!* Collingwood.
,, *trichomanoides*, Dryander. Foxhill; Collingwood, *D. Grant!*
Adiantum hispidulum, Swartz. Bishopdale, *D. Grant!*
,, *diaphanum*, Willd. Bateman's Gully, *D. Grant!*
,, *fulvum*, Raoul. Nelson; Mokohinui.
Pellæa falcata, Br. Mr. A. Collins' Bush, near Nelson, *D. Grant!*
Lomaria membranacea, Col. Nelson; Bishopdale, etc., *D. Grant!*
,, *banksii*, Hook. f. West Wanganui, etc., *D. Grant!*
,, *nigra*, Col. Collingwood, *D. Grant!*
,, *fraseri*, A Cunn. West Coast, as far South as Charlestown, but somewhat local.
Doodia media, Br. Port Hills, Nelson.
Polypodium tenellum, Forst. Not unfrequent in Suburban North, Nelson; Poor Man's Valley, etc.; *D. Grant!*
Schizæa fistulosa, Lab. Aorere Valley.

Lycopodiaceæ.

Lycopodium laterale, Br. Aorere Valley; plentiful.
Tmesipteris forsteri, Endlicher. On tree ferns, Maitai Valley; very local.

Addenda.

The following are stated to have been collected on Mount Franklin, by Mr. Park of the Geological Survey Department, on the authority of Mr. J. Buchanan ("Trans. N.Z. Inst.," vol. xvii., p. 356):—

Ranunculus lyallii, Hook. f.
Cotula pectinata, Hook. f.
Gentiana concinna, Hook. f.*
Veronica linifolia, Hook. f.
"*Mitrasacne cheesemanii*," J. Buch.
Ourisia macrocarpa, Hook. f.
Carex wakatipu, Petrie.

* Hitherto this species has only been recorded from the Auckland and Campbell Islands, and it is to be feared that a clerical error has occurred, Mount Franklin being a most unlikely habitat for a plant that can only exist when growing in peat.

Art. LIV.—*On a new Variety of* Desmid.

By W. M. Maskell, F.R.M.S.

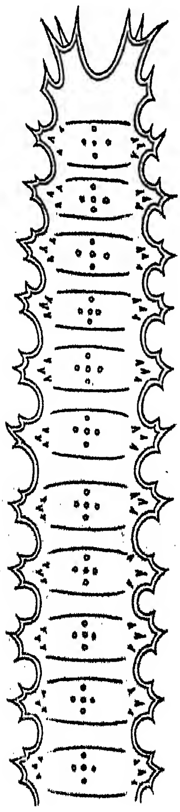
[*Read before the Wellington Philosophical Society, 24th February,* 1886.]

Genus **Triploceras**, Bailey.

Triploceras tridentatum, Maskell; var. *superbum*, var. nov.

Frond slender, elongated, cylindrical, very slightly depressed at the middle.

Denticulate lateral projections of the segments large, somewhat prominent, tri-dentate, the middle tooth the largest. Edges of frond between the projections slightly curved inwards, so that the segments appear as if with several toothed transverse rings. Denticulations pointing at right angles to segment near the constriction, and slightly forward near the extremities. The small processes at the base of the terminal tridentate prolongations sharply pointed forwards, not tri-apiculate. Terminal processes, 2, sub-rectangular, tri-dentate.



X 400

X 60

Endochrome, not very dark-green.

Length of frond, about 625 μ; breadth near constriction, about 50 μ.

From Wainui-o-mata, near Wellington.

This is a more ornate and elegant plant than *T. tridentatum*, or its other variety, *cylindricum*, on account of the more complex lateral denticulations. In the locality mentioned it seems to be somewhat abundant: it is quite constant in its characters.

IV.—GEOLOGY.

Art LV.—*On the Geology of Scinde Island.*

By Captain F. W. Hutton, F.G.S.

[*Read before the Philosophical Institute of Canterbury, 2nd July*, 1885.]

Plate XIII., fig. 6.

The first notice of the geology of the isolated, rocky bluff called "Scinde Island," on which the Town of Napier is partly built, is a section by Mr. Triphook, published by Dr. von Hochstetter in the "Reise der *Novara*" (Geologishert, Theil I., p. 2), but Dr. von Hochstetter did not himself visit the locality. This section is from Cape Kidnappers to Petane, and shows the Scinde Island rocks as an outlier of the Petane beds, which lie four or five miles to the north. Dr. von Hochstetter called them the "Hawke's Bay Series"—"limestones, sandstones, and clay-marls replete with fossils: *Pecten triphooki*, Zittel; *Venus*, *Mytilus*, *Pectunculus*, *Trochita*," etc., and considered them as belonging to the younger of the two systems into which he divided our tertiary rocks.

In 1871 Dr. Hector reported on the district, and agreed with Mr. Triphook, saying that the Scinde Island beds belonged to the upper part of the formation, and occupied the centre of a syncline from Cape Kidnappers to Pohui, which lies on the road from Napier to Lake Taupo.*

Among the tertiary fossils in the Colonial Museum at Wellington, which I examined in 1872, were some from "Napier and Cape Kidnappers,"† and these I referred to the "Ahuriri Formation" (since called the Ahuriri series of the Pareora system), making them older than the Wanganui Formation, ("Cat. Tert. Moll. and Echin. of N.Z.," p. 8,) which at that time was only known on the west coast of Wellington. There were no fossils from the Petane beds in the Museum, and, consequently, no opinion was expressed as to the age of that series.

* "Reports Geol. Survey," 1870-71, p. 159.

† "Catalogue of the Colonial Museum," 1870, p. 180.—"Limestones and clay-marls exposed in the cliffs around Scinde Island, and along the coast. The same formation is general throughout the east part of Hawke's Bay."

On the 27th November, 1876, Mr. S. Percy Smith read a paper to the Auckland Institute called a "Sketch of the Geology of the Northern Portion of Hawke's Bay," ("Trans. N.Z. Inst.," vol. ix., p. 565,) in which he makes the sandstone of Scinde Island and the Napier limestone to be the same as the Petane beds. He also gives a list of fossils from the different beds.

In March, 1876, Mr. S. H. Cox examined the country,* and stated that the Napier limestone underlaid the Petane beds at Scinde Island, and that it was the equivalent of the Pohui limestone at Te Waka, on the Taupo Road. He says: "At Scinde Island, Napier, where the typical development of these beds [Napier limestone, etc.,] occur, they are forming a low anticline, dipping on the sea-face, S. 10°, but on the harbour side N.W. 25°" (*l.c.*, p. 100). He considered that all the tertiary beds belonged to one series, without any uncomformity between them.

Dr. Hector, in his Progress Report for the same year, says that the fossils from the Petane series "seem to place them in the same horizon as the Upper Wanganui beds" (*l.c.*, p. viii.), but he considered the Napier limestone to be the same as the Petane limestone.

In the early part of 1877, Mr. A. McKay examined the district and reported that certain marls and pumice sands, which underlie the limestone at Puketapu (Petane limestone) form the lowest beds exposed on the south-west side of Scinde Island: that "they dip to the N.E,, bringing the limestones to the sea level at the north end of Shakespeare Road, but are found at a higher level in the Bluff along the sea beach," ("Rep. Geol. Exp.," 1856–7, p. 84,) thus forming a syncline. In his Progress Report for the year, Dr. Hector remarks that "the general results of this examination are that the Scinde Island limestone (=Napier limestone) is shown to be the highest marine bed in the district, being separated from the limestones of the Puketoi Range and Manawatu Gorge by a great series of fossiliferous sands and clays, estimated in the district west of Napier to be not less than 2,000 feet thick." (*l.c.*, p. 11.)

In August, 1878, Mr. A. McKay again visited the district south of Napier, and ascertained that the "pumice sands and lignite series" (*i.e.* the Petane series) rested unconformably on the Te Aute limestone (*i.e.* the Ahuriri series) at Mount Vernon, near Waipukurau ("Rep. Geol. Explorations," 1878–79, p. 72); and Dr. Hector remarks, in his Progress Report, that "as the former series (Petane series) is closed by the Scinde Island beds, the rocks at the town of Napier do not belong to the same horizon as the Te Aute limestone." (*l.c.*, p. 20.)

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* "Rep. Geol. Exp.," 1874-76, p. 96. This report was not published until 1877, after Mr. Percy Smith's paper had been read; so that each is independent of the other.

It thus appears that all the observers, except Mr. Cox, place the Napier or Scinde Island limestone in the upper part of the Wanganui system, which is directly opposed to the conclusion drawn from the published lists of fossils. The stratigraphical and palæontological evidence seemed therefore to clash, and I gladly availed myself of an opportunity that occurred last January of visiting Scinde Island to try to clear up the difficulty. This, with the able assistance of Mr. A. Hamilton, of Petane, and Mr. H. T. Hill, of Napier, I think I have accomplished.

The result of my examination is to show that the northern end of the island is formed by the Petane series. This series rests unconformably on the Scinde Island limestone, which forms, with the underlying sandstone, all the southern part of the island, as shown in the accompanying section. (Pl. XIII., fig. 6.)

Collections of fossils from here, and from Petane, prove the accuracy of Dr. Hector's opinion that the Petane beds are the equivalents of the Wanganui beds. The fossils from the Scinde Island limestone, however, show that it is the equivalent of the Te Aute limestone, which is the same as the Pohue limestone of Te Waka.

AHURIRI SERIES.

This series forms the main part of the island, from the southern end to beyond Curling's Gully on the eastern, and as far as the Taradale Bridge on the western side. It consists of the following rocks, in descending order:—

3. White earthy limestone, with bands of bluish-grey compact limestone with shells.
2. Yellowish sandstone, with irregular layers of compact limestone, passing downwards into—
1. Yellowish sandstone, glauconitic in places. The lowest bed seen.

All three pass gradually into each other.

On the south-east side of the island this series dips about S.E. 5°. To the northward, it gets horizontal, and then dips to the north-west. On the east side, at Curling's Gully, the dip is N.W. 20°; and on the west side, at Taradale Bridge, it is N.N.W. 10°. The limestone is quarried in many places. Fossils are generally in the form of casts, and are most abundant in the upper parts, especially in Curling's Gully and Milton Road. They are not, however, altogether absent in the lower sandstones. I noticed the following:—

1. *Siphonalia mandarina*, Duclos. (?)
*2. *Trochita neozelanica*, Lesson.
3. *Crepidula monoxyla*, Lesson.

---

* Abundant.

*4. *Crepidula incurva*, Zittel.
5. *Panopæa neozelanica*, Quoy. (?)
6. *Mactra discors*, Gray. (?)
7. *Hemimactra notata*, Hutton. (?)
8. *Hemimactra elongata*, Quoy. (?)
9. *Lutraria solida*, Hutton.
10. *Paphia neozelanica*, Chemnitz.
11. *Venus strutchburyi*, Gray.
12. *Venus sulcata*, Hutton.
13. *Dosinia subrosea*, Gray.
*14. *Cardita australis*, Lamarck.
*15. *Pectunculus laticostatus*, Quoy.
*16. *Mytilus magellanicus*, Lamarck.
17. *Modiola australis*, Gray.
*18. *Pecten triphooki*, Zittel.
19. *Pecten accrementus*, Hutton.
20. *Pecten chathamensis*, Hutton.
21. *Pecten neozelanica*, Gray.
*22. *Pecten burnetti*, Zittel.
*23. *Ostrea nelsoniana*, Zittel.
24. *Waldheimia patagonica*, Sowb.

All these species are found in rocks belonging to the Pareora system in other parts of New Zealand, except *Hemimactra notata* and *Mytilus magellanicus*, and the first of these is doubtfully identified from casts only. The following are characteristic Pareora fossils:—*Crepidula incurva*, *Pecten triphooki*, *Pecten accrementus*, *Pecten chathamensis*, *Pecten burnetti*, and *Waldheimia patagonica*. The last species ranges into the Oamaru system, but the other five are confined to the Pareora system. Of the 24 species enumerated, no less than 15, or 61 per cent., are recent. But this percentage of species is probably too large, as several of the fossils have been doubtfully referred to living species from casts alone, and they are mostly *Lamellibranchiata*, which have a longer specific life than *Gastropoda*. Future research will, no doubt, reduce the proportion of living species.

Petane Series.

This series occupies the north-east corner of the island. The unconformity between it and the underlying Scinde Island limestone is very apparent on the eastern shore, opposite the Spit. The unconformity is not so clear on the western side, owing to the large accumulations of the overlying brick-earth, or loam.

The series consists of the following:—

2. Shelly limestone, formed by comminuted shells, resting on—
1. Soft sandstone of a yellow, grey, or brown colour.

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* Abundant.

The limestone (*b* in the section) occupies very little of the surface, as it is covered over with the brick-earth. It can, however, be seen at the top of the cliffs at the north end of the island, and again a little north of Curling's Gully, where it is separated from the Scinde Island limestone by the sandstone (*c* in the section). This latter forms the base of the cliffs all along the north side, from near the Taradale Bridge to beyond Battery Point. Although I looked carefully, I could find no trace of the pumice beds said by Mr. McKay to underlie it.

The following is a list of the fossils we collected from these rocks :—

1. *Amphibola avellana*, Chemnitz.
2. *Ancillaria australis*, Sowb.
3. *Voluta pacifica*, Lamarck.
4. *Siphonalia mandarina*, Duclos.
5. *Cerithidea bicarinata*, Gray.
6. *Cerithidea tricarinata*, Hutton.
7. *Trochita neozelanica*, Lesson.
8. *Crepidula monoxyla*, Lesson.
9. *Turritella rosea*, Quoy.
10. *Turritella tricincta*, Hutton.
11. *Scalaria zelebori*, Frauenfeld.
12. *Turbo smaragdus*, Martyn.
13. *Rotella neozelanica*, Hombron.
14. *Dentalium nanum*, Hutton.
15. *Corbula erythrodon*, Lamarck.
16. *Hemimactra notata*, Hutton.
17. *Lutraria solida*, Hutton.
18. *Zenatia acinaces*, Quoy.
19. *Paphia neozelanica*, Chemnitz.
20. *Venus stutchburyi*, Gray.
21. *Venus meridionalis*, Sowerby.
22. *Venus sulcata*, Hutton.
23. *Venus mesodesma*, Quoy.
24. *Dosinia grayi*, Zittel.
25. *Tapes intermedia*, Quoy.
26. *Cardium striatulum*, Sowb.
27. *Loripes concinna*, Hutton.
28. *Cardita australis*, Lamarck.
29. *Pectunculus laticostatus*, Quoy.
30. *Pectunculus striatularis*, Lamarck.
31. *Mytilus magellanicus*, Lamarck.
32. *Mytilus latus*, Chemnitz.
33. *Modiola australis*, Gray.
34. *Pinna neozelanica*, Gray.
35. *Lima bullata*, Born.
36. *Pecten neozelanicus*, Gray.
37. *Pecten radiatus*, Hutton.

38. *Pecten semiplicatus*, Hutton.
39. *Pecten convexus*, Quoy.
40. *Pecten laticostatus*, Gray.
41. *Anomia alectus*, Gray.
42. *Ostrea edulis*, Linneus.
43. *Waldheimia ovalis*, Hutton.
44. *Terebratella rubicunda*, Solander.
45. *Rhynchonella nigricans*, Sowb.

Of these, *Dentalium nanum* is at present only known from the Wanganui system; while *Amphibola avellana*, *Cerithidea bicarinata*, *C. tricincta*, *Turbo smaragdus*, *Corbula erythrodon*, *Pectunculus striatularis*, *Pecten radiatus*, and *Mytilus latus* have not yet been found in the Pareora system. Of the 45 species enumerated, 38, or 84 per cent., are recent. A small rolled fragment of *Pecten triphooki* was also found, but it probably came out of the Scinde Island limestone. However, I found a broken and rolled specimen of this species at Moteo, near Puketapu, which possibly had not been derived from any older rocks.

BRICK-EARTH.

This formation forms the top of most of the hills, and lies quite unconformably on both the Ahuriri and the Petane series. It descends to the sea level on the east side of the island, in a valley a little south of Battery Point (*see* section), and also in two or three other places on the west side. It is a reddish-brown sandy clay, or loam, often showing the "capillary structure" of the so-called Loëss of Banks Peninsula; from which, however, it can be distinguished by its darker colour. I saw pumice in it in two places. One on a hill not far from the Hospital. The other in the valley just mentioned, south of Battery Point. In the latter place a considerable layer of pumice sand is seen on the northern slope of the valley, overlain by the brick-earth. In the other locality, small fragments of pumice are scattered through the brick-earth. At Battery Point a thin bed of shingle lies at the base of the brick-earth, but I saw no shingle at the south end of the island.

This loam bed is used for making bricks in Napier. It is also found in many places north of Napier, and is especially conspicuous on the hills near Puketapu.*

At the south-west end of the Bluff, at the sea level, below the limestone quarry worked by the prisoners, is a bed of clay containing fragments of rock, in which Mr. Hamilton informs me he has found moa bones. This clay may be of the same age as the brick-earth, or it may be younger. Probably the latter is the case, but I could not satisfy myself on this point.

* This is probably the "light-grey sandy marls," mentioned by Mr. McKay as seen on the road between Puketapu and Taradale ("Geol. Reports," 1876–77, p. 84); but it does not underlie "the limestone capping the hills to the north," as Mr. McKay appears to think; and it is not marly.

ART. LVI.—*New Species of Tertiary Shells.*

By Captain F. W. HUTTON, F.G.S.

[*Read before the Philosophical Institute of Canterbury, 2nd July*, 1885.]

IN this paper I give descriptions of a few more fossil shells. The list of New Zealand tertiary mollusca now numbers about 460 species, of which about 250 still remain unfigured.

CYLICHNA (VOLVULA) REFLEXA, n. s.

Shell sub-cylindrical, mucronate posteriorly, smooth, a few distant spiral lines at the anterior end. Aperture narrow, rather effuse anteriorly, the inner lip being strongly reflected over the columella. Length, 0·12 inch.

Locality. White Rock River, South Canterbury.

MUREX ESPINOSUS, n. s.

Shell fusiform, with a moderate canal and no spines. Whorls $5\frac{1}{2}$ – $6\frac{1}{2}$, the first embryonic, the others spirally and longitudinally ribbed. Longitudinal ribs rounded, distant, 8 or 9 on a whorl; spiral ribs strong, scaly, close, about 10 on the penultimate, and 25–30 on the body whorl; those just below the suture smaller than the others. Aperture oval, rather suddenly contracted into the moderate and slightly bent canal, which is more or less closed. Length, 1·2 inch; breadth, 0·6 inch.

Locality. Petane.

Distinguished from *M. octagonus* by the complete absence of spines.

NASSA SOCIALIS.

Nassa compta, Hutton, "Trans. N.Z. Inst," vol. ix., p. 296, pl. xvi., fig. 9; not of Adams.

COLUMBELLA ANGUSTATA, n. s.

Shell elongato-fusiform, spirally grooved, the spire longer than the aperture. Whorls 6–7, flattened, the suture distinct; spiral grooves narrow and rather distant, 7 on the penultimate, and about 15 on the body whorl. Aperture elongately-oval, not contracted in the middle; the outer lip thin (?) (broken). Length, 0·48; breadth, 0·15; aperture, 0·2 inch.

Locality. Petane. A single specimen.

PLEUROTOMA PLICATELLA, n. s.

Shell fusiform, the spire turreted, but not much larger than the body whorl. Whorls $8\frac{1}{2}$, the first $1\frac{1}{2}$ embryonic, the others spirally striated. Spire whorls longitudinally ribbed below the sinus area, and slightly so at the suture; about 15–17 in a whorl. The spiral striations extend over the whole surface, but are reduced to two in the sinus area. On the body whorl the

longitudinal ribs are obsolete, except at the suture, where they are tolerably strong; the spiral ribs are strong and irregular, the intermediate grooves sometimes as broad as the ribs, sometimes narrower. Aperture oval, with a very short anterior canal; the sinus deep, situated some distance below the suture. Length, 0·92; breadth, 0·38; aperture, 0·42 inch.

Locality. Wanganui.

DRILLIA ÆQUISTRIATA, n. s.

Whorls 8; the first 1½ embryonic, smooth, and expanded into a papilla, the others spirally striated and longitudinally ribbed in the centre, except the body whorl, on which the longitudinal ribs become gradually obsolete. There are 15 oblique longitudinal ribs on a whorl, crossed by numerous low and subequal spiral ribs. Sinus area concave and covering the suture, but spirally ribbed like the rest. Aperture oval; canal very short; posterior sinus small but distinct; the inner lip with a large posterior callus. Length, 0·75; breadth, 0·2; aperture, 0.34 inch.

Locality. Petane.

The spiral sculpture is much stronger than in *D. alabaster.*

NATICA DARWINII.

Natica solida, Sowb., in Darwin's "Geol. Obs. on South America," p. 255, pl. iii., f. 40-41 (1846); Zittel "Reise der *Novara,*" Palæ., p. 42, taf. xv., f. 6; not *N. solida,* Blainville, Malac., pl. 36, f. 8 (1825).

As Sowerby's name must sink into a synonym, I have called this species after the illustrious naturalist who collected it.

NATICA (NEVERITA) GIBBOSA.

Natica solida, "Cat. Tertiary Moll. of N.Z.," in part.

Shell large, solid, smooth, globose, the spire almost buried; the body whorl gibbous posteriorly. Aperture semicircular, the columellar callus very large, filling the posterior portion of the aperture, and eventually covering the whole umbilical region. Length, 2· inch; breath, 2· inch.

Locality. Trelissic Basin; White Rock River, and many other places.

Distinguished from *N. darwinii* by the short spire, the gibbous body whorl, and the covered umbilicus.

CERITHIUM NODOSUM.

Cerithium nodulosum, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 12; not of Brug.

BITTIUM CINCTUM, n. s.

Distinguished from *B. terebelloides* by its larger size, by the spire whorls having four, instead of three, spiral ribs, and by the body whorl having 6–8 spiral ribs.

Locality. Wanganui and Petane.

I have revived for this species the name which I formerly bestowed on *B. terebelloides*, Martens.

STRUTHIOLARIA CALCAR.

Struthiolaria cincta, var. C., Hutton, "Cat. Tertiary Moll. of N.Z.," p. 11.

This species has been found by Dr. von Haast at Tengawai Cliffs, South Canterbury; and, as it keeps its characteristic claw with great constancy, I think it deserves a specific name.

STRUTHIOLARIA SPINOSA.

Struthiolaria tuberculata, Hutton, "Cat. Tert. Moll. of N.Z.," in part.

I have now no doubt but that *S. tuberculata*, and its variety β. of my catalogue, are distinct species, and I propose to retain the name of *tuberculata* for the variety as more appropriate, and to call those forms with spinous tubercles *S. spinosa*. This latter species is found in the Trelissic Basin, etc., while *S. tuberculata* comes from White Rock River, etc.

CYCLOSTREMA OBLIQUATA, n. s.

Shell large, spiral, depressed, smooth (?), with a spiral groove above the periphery. Whorls 4, increasing rather rapidly. Suture deep; umbilicus wide. Aperture oval, very oblique. Peristome continuous, sharp. Greatest diameter, 0·8; least, 0·62; height, 0·63 inch.

Locality. Wanganui.

A single specimen sent by Mr. Drew. As the shell is worn, it is impossible to describe its external surface.

WALDHEIMIA OVALIS, n. s.

Shell thin, elongated, oval, the greatest width rather in front of the middle, tapering gradually towards the beak; front margin rounded. Surface smooth or with very fine concentric growth-lines. Valves nearly equally convex, the brachial valve regularly arched. Lateral margins nearly straight, anterior margin slightly sinuated, concave dorsally. Beak moderate, angled on each side; the foramen rather small, the deltoidal pieces well developed. Loop reaching nearly to the anterior margin, not much expanded; septum extending through half the length of the brachial valve. Length, 2·1; breadth, 1·5; depth, 1·1 inch.

Locality. Wanganui; Napier.

This species combines the shape of *W. vincentiana* with the small foramen of *W. lenticularis*.

Art. LVII.—*The Wanganui System.*

By Captain F. W. Hutton, F.G.S.

[*Read before the Philosophical Institute of Canterbury, 6th August*, 1885.]

Plates XII., XIII.

Dr. von Hochstetter, in 1864, placed the Wanganui River beds with his Hawke's Bay series, in the younger of the two groups into which he divided our tertiary rocks;[1] and he considered them to be of pliocene age. He did not, however, visit the district, and gave no list of fossils obtained from there.

In 1867, Mr. J. Buchanan, of the Geological Survey, made a large collection of fossils from between Wanganui and the Patea, and he divided the rocks into a lower blue clay and upper sandy beds.[2] These fossils were examined by Dr. Hector, who placed the upper sandy beds in the post-tertiary, and the lower blue clay in his upper tertiary or Struthiolaria beds, together with the blue clays of Awatere, Motunau, Awamoa, and other places.[3]

On a re-examination of these fossils, in 1872, I followed Dr. Hector in keeping the upper beds in the pleistocene, but separated the blue clay of Shakespeare Cliff from the other beds associated with it as a separate and younger formation, under the name of the Wanganui Formation.[4] This I considered to be pliocene, and the Awatere series to be upper miocene.

In 1875, Mr. A. McKay referred to the Wanganui Formation some conglomerates and highly fossiliferous sands with pumice overlying the Napier limestone, between Cape Kidnappers and the Mariatotara River.[5]

In 1876, Mr. S. H. Cox ascertained that a considerable thickness of marine strata, with abundance of fossils, mostly recent, were superimposed upon the Napier or Scinde Island limestone, in Hawke's Bay.[6] He gave a list of these fossils, which Dr. Hector pronounced to be the same as those from the upper beds at Wanganui, and he placed the rocks in the Wanganui Formation.[7]

In 1877, Mr. A. McKay traced these beds from the Manawatu Gorge to Napier,[8] giving them the name of Rotella beds. In

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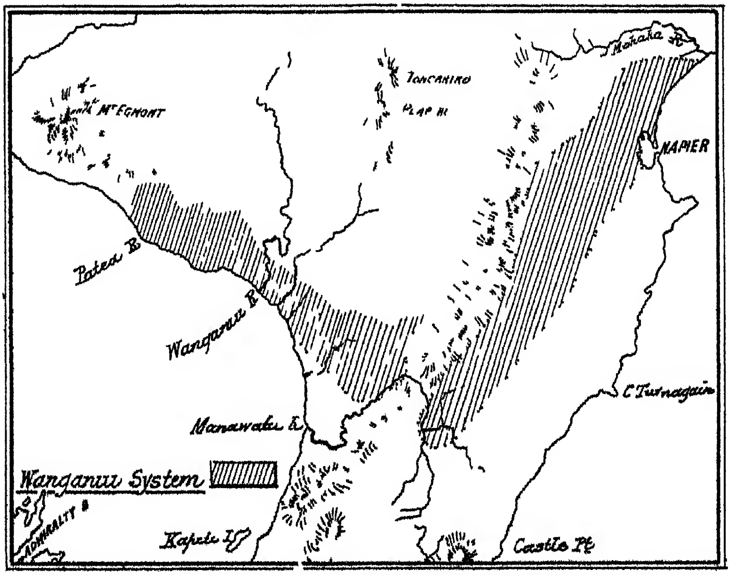
1 "Reise der *Novara*," Geologischer, Theil I., p. xl.
2 "Trans. N.Z. Inst.," vol. ii., p. 163.
3 "Catalogue of the Colonial Museum," Wellington, 1870, p. 172.
4 "Cat. Tert. Moll. and Echin. New Zealand," Wellington, 1873; and "Quart. Jour. of the Geol. Soc. of London," vol. xxix., p. 373.
5 "Rep. Geol. Expl.," 1874–76, pp. 44 and 49.
6 "Rep. Geol. Expl.," 1874-76, p. 96.
7 "Rep. Geol. Expl.," 1874-76, pp. viii. and x.
8 "Rep. Geol. Exp.," 1876-77, p. 79.



Shakespeare's Cliff

N. S

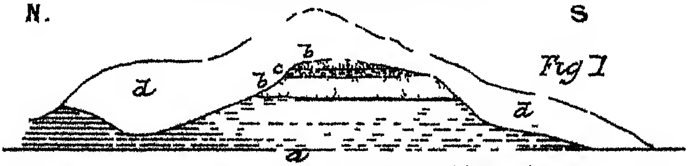


Fig 1

d Silt and gravel. b Sand (fossils)
c. Conglomerate a Blue clay (fossils

Putiki Point.

N.E. S.W.

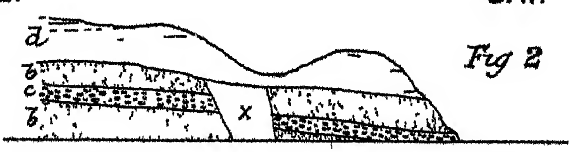


Fig 2

d Silt and gravel. b Sand with fossils
c Conglomerate X Slipped ground. (Fault).

To accompany Paper by F W Hutton.

the same year, Dr. Hector, in his new classification of formations, considered the upper beds at Wanganui to be pliocene; and he grouped them with the Hawke's Bay beds as the Kereru Rotella beds, subsequently called the Kereru series.[1] The blue clay of Shakespeare Cliff was now called the Wanganui series, and put into the upper miocene. Indeed, the Director of the Geological Survey has never acquiesced in my view that the Shakespeare Cliff clay is younger than the miocene. He has always considered it as upper miocene, placing it formerly with the Awatere series, but last year with the Te Aute limestone; the Awatere series being now made lower miocene.[2] It will thus be seen that the terms "Wanganui formation" or "Wanganui series" have been used sometimes for the upper sandy beds, sometimes for the underlying blue clay.

In January, 1884, I examined the Wanganui District, and came to the conclusion that the upper sandy beds cannot be separated from the blue clay; that all are of pliocene age, and very different, palæontologically, from the Awatere series or the Te Aute limestone. Accordingly, in a paper read to the Geological Society of London, in January, 1885, I proposed a Wanganui system to include both; distinguishing the beds at Wanganui as the Putiki series, those at Hawke's Bay as the Petane series, and those on the west side of the Ruataniwha Plains, in Waipawa County, as the Kereru series;[3] at the same time saying that these series were geographical only, and did not represent different epochs of time. I had not room in that paper to give all the evidence on which I relied for proving that these series formed a distinct system well marked off, both palæontologically and stratigraphically, from the older Pareora system; and the object of the present communication is to furnish this, together with other evidence, which I obtained during a visit to Hawke's Bay last January. However, in order to save space, I have not thought it necessary to give separate lists of the fossils from each locality, but have contented myself with one list of all the species known from the Wanganui system, with the localities in which each has been found. Kereru I have not visited, and have no list of fossils from there; but, according to Mr. McKay, they are the same as those found at Matapiro Station, on the Ngaruroro River. Of course my visits, both to Wanganui and to Hawke's Bay, were far too short to allow me to work out the stratigraphical relations of all the different beds; but I think that what I have seen, together with the large collections of fossils that I have examined, will be sufficient to lay the foundation for a correct classification of the beds, and will enable local geologists to work out the details.

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[1] "Rep. Geol. Exp.," 1876-77, p. 4.
[2] "Rep. Geol. Expl.," 1883, p. 13.
[3] "Quart. Jour. Geol. Soc.," vol. xli., p. 211.

Wanganui District.

The beds near the mouth of the Wanganui River were, I believe, first described by the Hon. W. Mantell in the "Quarterly Journal of the Geological Society of London,"[1] but, unfortunately, I am unable to refer to his papers. In 1867, Mr. J. Buchanan examined the district for the Geological Survey of New Zealand. The results of his researches, together with a section of Shakespeare Cliff, were published in 1869 in the "Transactions of the N.Z. Institute."[2] He divided the rocks into "an upper sandy and lower clay stratum, and separated by a deposit of sand of varying thickness, being at least 12 feet at Shakespeare Cliff, at Wanganui, the whole covered by a heavy deposit of sands and gravels containing a cemented gravel bed, also of variable thickness, the material from which is in common use for the construction of roads throughout the district."

In 1874, Mr. C. W. Purnell read a paper to the Wellington Philosophical Society "On the Wanganui Tertiaries."[3] He divides the beds into three groups. "The oldest fossiliferous stratum within a radius of four or five miles from the town of Wanganui is the tuff [with pumice] in the cliffs on the east bank of the river [at Kaimatera]; the next oldest, the blue clay, at Shakespeare Cliff; and the youngest, the beds overlying the blue clay and those at the Landguard Bluff." Mr. Purnell, however, mistook ordinary clay for "volcanic mud," and he considered the recent alluvial deposits of the river, containing pumice, to pass under the blue clay at Shakespeare Cliff.

In 1875, Mr. Kirk made a collection of fossils from Wanganui for the Wellington Museum.[4]

In 1882, I received from Mr. S. H. Drew, of Wanganui, a collection of fossils made in the neighbourhood, with the request that I would name them for him. It contained several new species, which I described in the "Trans. N.Z. Inst.," vol. xv., p. 410. In 1883, I again received another and much larger collection, which also contained some new forms, and I came to the conclusion that it would be advisable to publish a new list of all the mollusca which had been recorded from this interesting locality. However, before doing so, I wished to examine the district myself. Accordingly, in January, 1884, I paid a visit to Wanganui, and, under Mr. Drew's guidance, spent three days in examining the sections near the town, and one day at Patea, with the following results.

The base of Shakespeare Cliff, which stands on the left bank of the river, opposite to the town of Wanganui, is formed

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1 "Quart. Jour. Geol. Soc.," vol. iv., p. 239, and vol. vi., p. 332.
2 "Transactions," vol. ii., p. 163.
3 "Trans. N.Z. Inst.," vol. vii., p. 453.
4 "Rep. Geol. Expl.," 1881, p. 128, Nos. 206-208.

of blue clay (Pl. XII., fig. 1, *a*), about 40 feet thick, and full of fossils. A layer of yellow sand (*b*) rests upon this clay, apparently quite conformably; it is about 20 feet thick, and contains broken shells. Then comes a thin bed of sand, about 4 feet thick, with abundance of fossils. Then another bed of sand, about the same thickness, followed by a bed of gravel (*c*) cemented by iron oxide. This is followed by a bed of dark green sand (*b*). All these belong to the Wanganui system; they have suffered much denudation, and are overlain quite unconformably by a series of silts and gravels (*d*) which are unfossiliferous.

At Landguard Bluff, or Putiki, near the mouth of the river on the left bank, the blue clay is not seen, but the upper beds are largely developed. The lowest stratum is yellow sand with broken shells, followed by sand with shells (Fig. 2, *b*), sands and clay, cemented gravel (*c*), and greensand, as at Shakespeare Cliff. But above the greensand is another bed of sand with shells (*b*) and white clay. At the point forming the Bluff, there is a fault of about 30 feet (*x*), caused apparently by a land slip. Round the point some small beds of lignite lie on the cemented gravel. The upper beds are denuded, and overlain unconformably by unfossiliferous silt and gravels, as at Shakespeare Cliff.

The Wanganui system in this district may therefore be represented as follows, the known thickness being between 150 and 200 feet:—

Putiki Series, near Wanganui.

9. White clay, about 4 feet.
8. Sand, about 12 feet.
7. Sand with fossils, about 5 feet.
6. Greensand, current bedded, about 25 feet.
5. Cemented gravel, from 10 to 20 feet.
4. Sand with clay, from 4 to 50 feet.
3. Sand with fossils, from 4 to 10 feet.
2. Sand with broken shells, from 12 to 20 feet.
1. Blue clay with fossils, 40 + feet. Bottom not known.

No pumice has been found in any of these beds. The blue clay is quite conformable to the upper beds, and contains the same fossils. I know 133 species of mollusca from the blue clay, all but 21 of which also occur either in the upper beds or in the Petane series. But of these 21, thirteen are still living in the New Zealand seas, and must therefore have been living when the upper beds were being deposited, although their remains have not yet been found in them. This leaves eight species out of 133, as distinctive of the blue clay, and of these only one—*Vermetus moniliferus*—is found in the Pareora system. This small difference between the fossils of the blue clay and those of the upper beds is easily accounted for by difference of station;

it is much less than the difference between the upper beds and the Petane series. The number of species from the upper sandy beds is 156, of which 72 per cent. are recent; while of the 133 species from the blue clay, 77 per cent. are recent. Evidently we cannot disconnect the blue clay from the upper beds.

On the sea coast at Patea, south of the mouth of the river, blue clay with fossils passes up gradually into a blue micaceous sandy clay, apparently unfossiliferous. Upon this lies about 12 feet of yellow sand; then cemented gravel 4 feet thick, followed by gray sands, and then red and yellow sands. The upper beds form the cliff, and not being very accessible, I did not examine them closely, but I could find no fossils in the tumbled blocks. The sequence is remarkably like that at Wanganui. The yellow sand is distinctly separated from the blue micaceous clay upon which it rests, but without any appearance of unconformity. The number of species obtained from the blue clay is 26, of which 77 per cent. are recent. Three species of Pareora shells, not known from any other part of the Wanganui system, have been found in the blue clay at Patea. They are *Oliva neozelanica*, *Struthiolaria cingulata*, and a species of *Cucullæa* (fragments).

On the left bank of the Wanganui River, about four miles above the town, a very good section is seen at Kaimatera Cliff; but the beds here differ much from those at Putiki Point. The lowest beds seen are a series of sands and silts (Pl. XIII., fig. 8, *a*), without fossils. These are overlain, apparently unconformably, by a bed of sand with shells and numerous small fragments of pumice. This is followed by a thick series of sands much current-bedded (*b*); this again by a loosely cemented gravel-bed (*c*). Over this comes another bed of sand with fossils; the whole being covered unconformably by unfossiliferous silt and gravel (*d*), as at Wanganui. These beds, *b* and *c*, may be called the Kaimatera beds. We obtained, in a few hours, 47 species of shells from these sands, 44 of which, or 93 per cent., were recent. The three supposed extinct species are *Trophon expansus*, *Trochita inflata*, and *Risella melanostoma*. Of these, the two first are closely allied to living species, and the third is abundant in Australia and Tasmania; consequently, I think that these beds are of pleistocene age, and should be kept out of the Wanganui system. Whether the apparent unconformity between *a* and *b* is a real one or not I cannot say, as the upper beds are much current-bedded, and the exposed section is two short to place much dependence on.

Hawke's Bay District.

Dr. Hector was the first to report on this district. He described the tertiary rocks from the Upper Mohaka to Petane,

and considered that that portion lying between Pohui and the Mangapikopiko (=Purohutangihia) Range was an older formation underlying unconformably the limestones of Te Waka and the Purohutangihia.[1]

In 1876, Mr. S. H. Cox considered that the whole of the tertiary rocks from Pohui to Napier formed a single comformable series, which might possibly be divided into upper and lower.[2] In the same year, Mr. Percy Smith recognised an unconformity near Pohui, between the Mangaharuru sandstone and the overlying beds to the south.[3]

In 1877, Mr. A. McKay gave a section along the Ngaruroro River,[4] which, as well as the geological map of the neighbourhood, appears to be very correct in all the places examined by me.

Last January I spent a fortnight in Hawke's Bay, and, accompanied by Mr. A. Hamilton, who had previously sent me many fossils, I examined the section from the Upper Mohaka to Petane, the country about Puketapu, and the valley of the Ngaruroro River, from Hastings to Kikowheru Creek, on Mr. Walter Shrimpton's station of Matapiro. I made the following observations.

In the Upper Mohaka, where the road from Napier to Lake Taupo crosses the river, the rocks are grey or brown argillaceous sandstone (Fig. 4, *a*), containing the following fossils :—*Struthiolaria tuberculata*, *S. sulcata*, and a species of *Cucullæa*. They may be referred with safety to the Pareora system. These beds are very thick, more than 800 feet, and are overlain by a thick stratum of hard shelly limestone (*b*) forming the Te Waka Range, and known as the Pohui limestone. At the Mohaka the beds dip to the S.E., at an angle of 25°, but at Pohui they flatten to S.S.E. 10°.

South of Pohui, we came across a newer series of rocks, resting uncomformably on the denuded surface of the Pohui limestone and the underlying sandstones. This is the commencement of the Petane series. It dips here about S.S.E. 15°, and at Petane not more than 6° to the S.S.E., but a slight anticlinal fold occurs before reaching Petane (fig. 4). The rocks of the series are as follows, in descending order :—

5. Two or more thick bands of limestone, with beds of calcareous sand (Petane limestone), sometimes passing into blue clay (*f*).
4. Brown sandstones, with a band of conglomerate (*e*).
3. Blue clay, known locally as "papa," (*d*).

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1 "Rep. Geol. Expl.," 1870-71, p. 158.
2 "Rep. Geol. Expl.," 1874-76, p. 97.
3 "Trans. N.Z. Inst.," vol. ix., p. 565.
4 "Rep. Geol. Expl.," 1876-77, p. 83, and sec. No. 5.

2. Grey and brown sandstone, with several bands of conglomerate (*c*).
1. Bluish argillaceous sandstone (*c*).

The whole series is estimated by Mr. Percy Smith to be 4,500 feet in thickness. I could detect no pumice in any of these beds, but it occurs in abundance at Titiokura Saddle, between Pohui and the Mohaka,[1] and at other places in beds lying unconformably on the Petane series, as has already been pointed out by Mr. Cox. I know 174 species of mollusca from the upper beds (4 and 5), of which 65 per cent. are recent.

At Puketapu, on the Tutaekuri River, the Petane limestone is largely developed, and can be well studied on both banks of the river at Moteo, a little above Puketapu. Here, amongst other shells, we found a broken and worn fragment of *Pecten triphooki*, which is now in my collection. It is doubtful whether this is a rolled fragment derived from the Napier limestone, or whether it lived during the Wanganui period. If the latter be correct, other specimens will, no doubt, be found. Below the limestone comes a calcareous sandstone, and a little higher up the river this is seen to be underlain by sands and shingle-beds, with fossils, like those at Petane. There is no appearance of the blue clay here; neither could we find the pumice sands, mentioned by Mr. McKay as occurring under the limestone at Puketapu.[2]

At Matapiro Station, on the Ngaruroro River, the limestones and calcareous sands (Pl. XIII., fig. 5, *c*) belonging to the Petane series, which form the tops of the hills, are underlain by a thick bed of sandy clay (*b*); and below this, in the bed of the Kikowheru Creek, occur beds of fine gravel, sand, and thin beds of clay (*a*), dipping S.E. at angles varying from 25° to 6°. These contain abundance of fossils. We collected 96 species, of which 71 per cent. are recent. In some very limited spots the sands are pale yellowish-white and of small specific gravity. These patches may be formed of decomposed pumice, although I could not recognise pumice with certainty by means of a lens. No doubt they are the pumice sands mentioned by Mr. McKay as occurring sparingly in Kikowheru Creek.[3]

Relation to the Pareora System.

No junction between the Wanganui system and the Pareora system has as yet been observed on the western side of the Wellington Provincial District, although the Pareora system undoubtedly exists up the Waitotara River. But on the eastern

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[1] These pumice beds are very different from those which *overlie the river gravels* in the Mohaka Valley.
[2] "Rep. Geol. Expl.," 1876-77, p. 84.
[3] "Rep. Geol. Expl.," 1876-77, p. 88.

N. —Kaimatera Cliff.— S.

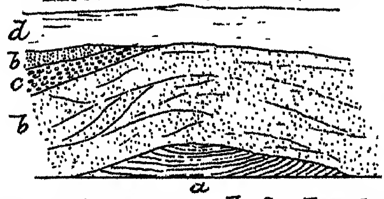
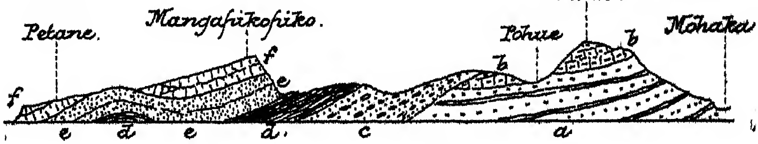


Fig 3.

d. Silt and gravel. b. Sand with pumice. (Fossils).
c. Conglomerate. a. Putiki series?

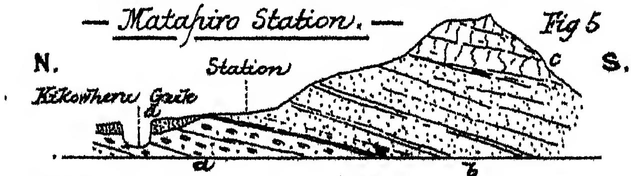
—Petane to the Upper Mohaka.— Fig 4.

Distance 23 miles.



f. Petane Limestone &c. c. Brown & bluish Sandstone.
e. Brown Sandstone. b. Pohue or Te Aute Limestone.
d. Blue clay. a. Grey & brown Sandstone.
a. and b. belong to the Pareora System.

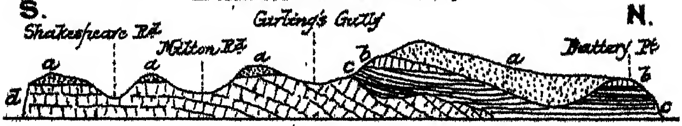
— Matapiro Station. —



d River gravels. b Blue sandy clay.
c. Petane Limestone &c. a. Sands & gravels.

—Section through Scinde Island.—

Distance about 1 mile.



a. Brick earth, or loam, with Pumice .... Pleistocene.
b. Limestone } Petane Series .... Pliocene.
c. Sandstone }
d. Scinde Id. Limestone & Ahuriri Series ...... Miocene.

To accompany Paper by F. W. Hutton.

side of the Wellington Provincial District, and in Hawke's Bay, several junctions occur.

1. At Pohui, on the Napier and Taupo Road, an unconformity exists, as was first pointed out by Mr. Percy Smith. (*See* fig. 4.) According to Mr. Percy Smith, this unconformity is very plain some 12 or 14 miles north of the road, where the lowest beds of the Petane series, called "Middle Papa" by Mr. Smith, dipping at an angle of about 10°, abut against the steep face of the "Maungaharuru sandstone" (Pareora system) at an angle of 29° 30′. "This unconformity," Mr. Smith says, "is a marked feature in viewing the country anywhere near the line of strike of the beds, where the older strata . . . are seen dipping at a considerable angle, forming hills which are quite characteristic and different in shape to the Papa hills of the overlying formation."[1]

2. At Napier, the unconformity between the two systems is quite clear; but this I have described in another paper read this year to the Institute ("On the Geology of Scinde Island").

3. Further south, Mr. McKay has shown complete unconformity between the two systems at Mount Vernon, near Waipukurau.[2]

4. In the East Wairarapa the pliocene beds on the east side of Palliser Bay, which probably belong to the Wanganui system, are said by Mr. McKay to be unconformable to the upper miocene rocks (Pareora system) upon which they rest.[3]

5. Again, Dr. Hector has shown that the pliocene (Wanganui) and miocene (Pareora) systems are unconformable at Oneira in Taranaki.[4]

We may, therefore, confidently assert that there is a wide spread unconformity between these two systems, and that they are separated by a period of elevation during which denudation was active.

Of the 279 species of mollusca known from the Wanganui system, 179 are not found in the Pareora or older rocks. While of 233 species found in the Pareora system, 130 are not found in the Wanganui system, nor in the seas of New Zealand.[5] The palæontological break is, therefore, well marked. The principal characteristics of the Wanganui system are the presence of *Trophon*, *Columbella*, *Turricula*, and *Mytilicardia*; as well as the

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[1] "Trans. N.Z. Inst.," vol. ix., p. 568, pl. xiii., sec. No. 2. In section No. 1 of this paper, No. 7 (Middle Papa) should evidently be No. 9 (gritty sandstone). No. 7 apparently thins out to the south before reaching Pohui, as mentioned by Mr. Smith on page 569.

[2] "Rep. Geol. Expl.," 1878-79, p. 72.

[3] "Rep. Geol. Exl.," 1878-79, p. 84.

[4] "Rep. Geol. Expl.," 1866-67, p. 2, and section.

[5] The discrepancy between these numbers is owing to three species of recent mollusca occurring in the Pareora system, none of which have as yet been found in the Wanganui system.

absence of *Peristernia*, *Nassa*, *Mitra*, *Conus*, and *Limopsis*, all of which occur in the Pareora system. Also, in the Wanganui system, the species of *Turritella*, *Dentalium*, *Cytherea*, *Cardium*, *Pecten*, and *Ostrea*, are small in comparison with the large species of each of these genera found in the Pareora system.

Divisions of the Wanganui System.

The following ten or eleven species of Pareora mollusca have been found in the Petane series, but not at Wanganui nor at Patea:—*Siphonalia nodosa* var. *conoidea*; *Pleurotoma pagoda*, *Natica gibbosa*, *Struthiolaria frazeri*, *Trochita alta*, *Turritella ambulacrum*, *Venus meridionalis*, *Cardita patagonica*, *Perna*, sp. ind.; *Pecten triphooki* (?), *Pecten semiplicatus*. I therefore suppose that this series is older than the blue clay of Shakespeare Cliff. This opinion is confirmed by the percentage of living species found in the beds, which is 65 to 71 per cent. in the Petane series, and 72 to 77 per cent. in the Putiki series. We may therefore provisionally divide the Wanganui system into two series, which may perhaps overlap in time:—

2. *Putiki Series*, including the blue clay of Shakespeare Cliff and Patea.
1. *Petane Series*, from the River Esk to the Ngaruroro.

The Kaimatera beds should be separated from both these series, and referred probably to the pleistocene period.

The position of the Kereru series still remains uncertain, as no list of fossils from that locality has as yet been published. According to Mr. McKay,[1] and to Mr. Cox,[2] the series contains considerable quantities of pumice sand, and possibly, therefore, it is on the same horizon as the Kaimatera beds.

The value of taking the percentage of recent species of mollusca in a tertiary rock, as a test of its relative age, has sometimes been called in question. This has arisen, I think, from a misconception of the limits of the method. If it be true that species have gradually changed, or that they have been gradually introduced into an area—which no one disputes—then it must be true that, in each epoch, the nearer we approach to the present time the nearer must be the resemblance between the fauna of the epoch and that of the present time. Indeed, the same holds good if, instead of assuming gradual change, we assume that the ancient fauna was altered by successive migrations into the area; for it is evident that the percentage test would be of great value here in ascertaining the relative ages of the various migrations; for each migration would bring many species similar to or allied to those now living, consequently the percentage system is of the greatest importance in testing

1 "Rep. Geol. Expl.," 1876-77, p. 82.
2 "Rep. Geol. Expl.," 1882, p. 3.

the relative ages of any two sets of beds belonging to the same biological province. But it does not follow that this method can be trusted for correlating with accuracy sets of beds in widely distant areas. On the contrary, different districts have undergone different physical changes, and we have therefore every reason to suppose that alterations in floras and faunas would proceed with unequal rapidity in different parts of the world. At the same time, as the replacement of a whole marine fauna can rarely be sudden, it follows that the percentage system has some value even here. But it must always be used in conjunction with a comparison of the specific forms of the two areas. And here, again, it is only the wide ranging oceanic, or deep sea species—such as sharks, cephalopods, and a few bivalves—which should be depended upon for evidence, but these wide ranging forms are of the very greatest value in correlating strata all over the world.

In the present case we have no wide ranging species that can help us in determining the European equivalent of the Wanganui system, and the percentage of recent species is our only resource. All geologists, however, would, I think, allow that it belongs to pliocene, the only question being: to what part of the pliocene should it be referred? and this may be left for the present undecided. Excluding the Kaimatera beds there are 278 species of mollusca known from the system, and of these 63 per cent. only are recent. This percentage is, however, likely to be increased, as many of the supposed extinct species are minute, and may have been overlooked as living forms. The reason the percentage of recent species is less in the whole system than in any of its separate series or beds, is that the recent species are more abundant individually, and more widely distributed, than the extinct forms, which are usually rare and local. The following genera, found in the Wanganui system, are not known to live in the seas of New Zealand:—*Ringicula*, *Oliva*, *Sigaretus*, *Eulima*, *Eulimella*, *Admete*, *Cerithium*, *Risella*, *Lutraria*, *Loripes*, *Macrodon*, *Cucullæa* (?), *Perna*; but probably those genera which contain minute species only will yet be detected.

Of the localities attached to the species in the following list, "Putiki" means the upper sandy beds of the Wanganui system in the neighbourhood of Wanganui. "Shakespeare Cliff" means the blue clay at Shakespeare Cliff, and on the sea coast near Wanganui. "Petane" means the district round Petane, including Napier and Puketapu.

Descriptions of the corals and Bryozoa from Wanganui will be found in the "Palæontology of New Zealand," part iv., by the Rev. J. Tenison-Woods (Wellington, 1880). A few Bryozoa from

Petane are mentioned by Mr. Waters in the "Quarterly Journal of the Geological Society of London," vols. xxxix. and xl., and a list by Mr. G. R. Vine, junr., of the Foraminifera from Petane, is given by Mr. A. Hamilton, in the "Transactions of the New Zealand Institute," vol. xiii., p. 393.

Mollusca of the Wanganui System.

CEPHALOPODA.

1. *Sepia*, sp.
   Petane. Two small delicate mucrones, apparently belonging to this genus.

GASTROPODA.

Pulmonata.

2. *Patula coma*, Gray, in Dieffenbach's "New Zealand," vol. ii., p. 263.
   Petane.
3. *Therasia thaisa*, Hutton, "Trans. N.Z. Inst.," vol. xvi., p. 182.
   Petane; Matapiro.
4. *Amphibola avellana*, Chemnitz, "Conch. Cab.," vol. v., f. 1919, 1920.
   Napier.

Opisthobranchiata.

5. *Ringicula uniplicata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 313.
   Petane.
6. *Tornatina pachys*, Watson, "Lin. Soc. Jour.," vol. xvii., p. 331.
   Wanganui; Petane; Shakespeare Cliff.
7. *Tornatella alba*, Hutton, "Cat. Marine Moll. of N.Z.," p. 51 (*Buccinulus*).
   Shakespeare Cliff; Wanganui.
8. *Tornatella kirki*, Hutton, "Cat. Marine Moll. of N.Z.," p. 51 (*Buccinulus*).
   Shakespeare Cliff. Rare. Perhaps a variety of the last species.
9. *Cylichna striata*, Hutton, "Cat. Marine Moll. of N.Z.," p. 52.
   Petane. Found also in the Pareora system.

Protobranchiata.

10. *Murex angasi*, Crosse, "Jour. de Conch.," vol. xi., p. 86, pl. 1 (*Typhis*); *T. zealandica*, Hutton, "Cat. Tert. Moll. of N.Z.," p. 2.
    Shakespeare Cliff.

11. *Murex neozelanicus*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool., ii., p. 529, pl. 36, f. 5–7.
Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

12. *Murex octagonus*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool., ii., p. 531, pl. 36, f. 8–9.
Shakespeare Cliff; Wanganui.

13. *Murex espinosus*, Hutton, "Trans. N.Z. Inst.," vol. xviii.
Petane; Matapiro.

14. *Trophon ambiguus*, Philippi, Abbild., *Fusus*, pl. 1, f. 2.
Wanganui; Kaimatera; Petane; Matapiro; Shakespeare Cliff.

15. *Trophon cretaceus*, Reeve, "Conch. Icon.," *Fusus*, f. 48.
Wanganui; Shakespeare Cliff. A large series of specimens have led me to think that this species is distinct from the last. It is distinguished by the more numerous spiral ribs.

16. *Trophon stangeri*, Gray, (*Fusus*), "Dieff. N.Z.," vol. ii., p. 230.
Wanganui; Kaimatera.

17. *Trophon cheesemani*, Hutton, (*Purpura*), "Trans. N.Z. Inst.," vol. xv., p. 131.
Wanganui; Kaimatera.

18. *Trophon duodecimus*, Gray, in "Dieff. N.Z.," vol. ii., p. 230.
Wanganui; Kaimatera; Petane; Matapiro; Shakespeare Cliff.

19. *Trophon crispus*, Gould, (*Fusus*), "Pro. Bost. Soc. Nat. Hist." vol. iii., p. 141.
Wanganui; Petane; Matapiro; Shakespeare Cliff. Still living at Terra del Fuego. Our species may be distinct.

20. *Trophon expansus*, Hutton, "Trans. N.Z. Inst.," vol. xv., p. 410.
Wanganui; Kaimatera; Petane; Matapiro; Shakespeare Cliff.

21. *Trophon plebeius*, Hutton, (*Fusus*), "Cat. Marine Moll. of N.Z.," p. 9.
Wanganui; Kaimatera; Petane; Matapiro; Shakespeare Cliff.

22. *Polytropa striata*, Martyn, "Univ. Conch.," pl. 7 (*Buccinum*).
Kaimatera.

23. *Fusus australis*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool., ii., p. 495, pl. 34, f. 9–14.
Wanganui; Kaimatera; Shakespeare Cliff.

24. *Fusus spiralis*, Adams, "Pro. Zool. Soc.," 1855, p. 221.
Petane; Shakespeare Cliff.

25. *Taron dubius*, Hutton, (*Trophon*), "Jour. de Conch.," xxvi., p. 13.
Wanganui.

26. *Siphonalia mandarina*, Duclos, "Mag. Zool.," viii.
Wanganui; Kaimatera; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

27. *Siphonalia caudata*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. ii., p. 503, pl. 34, f. 20–21.
Wanganui. Found also in the Pareora system. Perhaps a variety of the last.

28. *Siphonalia dilatata*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. ii., p. 498, pl. 34, f. 15–16. *Fusus subreflexus*, Sowb. in "Darwin's Geol. Obs. in S. America."
Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

29. *Siphonalia nodosa*, Martyn, "Univ. Conch.," *Buccinum*, pl. 5. *S. nodosa*, var. B. (Hutton), is the young.
Kaimatera; Shakespeare Cliff; Patea; Petane; Matapiro. Found also in the Pareora system.

Var. *conoidea*, Hutton; *S. nodosa*, var. D., Hutton, "Cat. Tert. Moll. of N.Z."
Petane; Matapiro. Found also in the Pareora system. Possibly the same as *Purpura conoidea*, Zittel.

30. *Siphonalia subnodosa*, Hutton, "Trans. N.Z. Inst.," vol. ix., p. 596, pl. xvi., f. 7 (*Cominella*); *S. nodosa*, var. C., Hutton, "Cat. Tert. Moll. of N.Z."
Shakespeare Cliff; Matapiro. Found also in the Pareora system.

31. *Siphonalia* (?) *cingulata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 315.
Shakespeare Cliff; Petane.

32. *Pisania lineata*, Martyn, "Univ. Conch.," *Bucc.*, pl. 48.
Wanganui; Kaimatera; Petane; Shakespeare Cliff. Found also in the Pareora system.

Var. *traversi*, Hutton, "Cat. Marine Moll. of N.Z.," p. 9 (*Fusus*).
Wanganui.

33. *Pisania striatula*, Hutton; *Cominella striata*, Hutton, "Trans. N.Z. Inst.," vol. vii., p. 458; not *Pisania striata*, Gml.
Wanganui; Petane; Matapiro; Shakespeare Cliff.

34. *Pisania drewi*, Hutton, "Trans. N.Z. Inst.," vol. xv., p. 410.
Wanganui; Petane.

35. *Cominella maculata*, Martyn, "Univ. Conch.," *Bucc.*, pl. 49.
Wanganui; Matapiro (a large variety). Found also in the Pareora system.

36. *Cominella maculosa*, Martyn, "Univ. Conch.," *Bucc.*, pl. 8.
Petane.

37. *Cominella virgata*, Adams, "Gen. Moll.," pl. 16, f. 6*a*.
Shakespeare Cliff; Kaimatera.

38. *Cominella antarctica*, Reeve, "Conch. Icon.," *Buccinum*, f. 30.
Petane; Matapiro.

39. *Cominella accuminata*, Hutton; *C. elongata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 315, pl. 18, f. 5; not *C. elongata*, Dunker.
Shakespeare Cliff.

40. *Cominella lurida*, Philippi, "Zeitschrift f. Malak." 1848, p. 187.
Wanganui; Petane; Matapiro; Shakespeare Cliff.

41. *Cominella nassoides*, Reeve, "Conch. Icon.," *Buccinum*, f. 12.
Petane.

42. *Cominella huttoni*, Kobelt, "Cat. d. Gattung," *Cominella*, p. 233.
Matapiro.

43. *Oliva neozelanica*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 314, pl. 18, f. 1.
Patea. Found also in the Pareora system.

44. *Ancillaria australis*, Sowb., "Sp. Conch.," 1830, pl. 7, f. 44–46.
Kaimatera; Wanganui; Patea; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

45. *Ancillaria lata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 325.
Patea; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

46. *Columbella varians*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 314, pl. 18, f. 2.
Petane; Shakespeare Cliff.

47. *Columbella choava*, Reeve, "Conch. Icon.," f. 289.
Wanganui; Petane; Shakespeare Cliff.

48. *Columbella pisaniopsis*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 314.
Petane; Matapiro.

49. *Columbella cancellaria*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 314.
Wanganui; Petane.

50. *Columbella angustata*, Hutton, "Trans. N.Z. Inst.," vol. xviii.
Petane.

51. *Marginella translucida*, Sowb., "Thes. Conch.," vol. i., p. 376.
Wanganui; Petane; Matapiro. Found living in Australia. This may be the *M. propinqua* (Tate), referred to by Mr. T. W. Kirk in "Trans. N.Z. Inst.," vol. xiv., p. 409.

52. *Marginella attenuata*, Reeve, "Conch. Icon.," f. 116; *M. hectori*, Kirk, "Trans. N.Z. Inst., vol. xiv., p. 409.
Petane. Found living in Australia.

53. *Marginella angasi*, Brazier, "Jour. de Conch.," 1870, p. 304.
Wanganui. Found living in Australia.

54. *Voluta pacifica*, Solander, "Cat. Portland Mus.," No. 4039
Shakespeare Cliff; Patea; Petane; Matapiro; Wanganui. Found also in the Pareora system.

Var. *elongata*, Swainson, "Exot. Conch.," pl. 20, 21.

Wanganui. Found also in the Pareora system.

55. *Voluta gracilis*, Swainson, "Exot. Conch.," pl. 42, 43.
Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

56. *Turricula rubiginosa*, Hutton, (*Mitra*), "Cat. Marine Moll. of N.Z." p. 20.
Wanganui; Petane.

57. *Turricula marginata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 315, pl. 18, f. 4.
Wanganui.

58. *Turricula planata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 315, pl. 18, f. 3.
Wanganui.

59. *Turricula lincta*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 326.
Petane.

60. *Terebra tristis*, Deshayes, "Pro. Zool. Soc.," 1859.
Shakespeare Cliff; Kaimatera; Patea; Petane.

61. *Terebra costata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 315, pl. 18, f. 6.
Wanganui; Petane; Matapiro. Found also in the Pareora system.

62. *Pleurotoma pagoda*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 5.
Petane; Matapiro. Found also in the Pareora system.

63. *Pleurotoma albula*, Hutton, "Cat. Marine Moll. of N.Z." p. 12.
Petane; Matapiro. Found also in the Pareora system.

64. *Pleurotoma nexilis*, Hutton, "Trans. N.Z. Inst." vol. xvii., p. 317, pl. 18, f. 9. (*Clathurella?*)
Wanganui; Petane.

65. *Pleurotoma buchanani*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 4.
Wanganui; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

66. *Pleurotoma neozelanica*, Smith, "Ann. and Mag. Nat. Hist.," series 4, vol. xix., p. 492.
Petane; Shakespeare Cliff.

67. *Pleurotoma tuberculata*, Kirk, "Trans. N.Z. Inst.," vol. xiv., p. 409.
Petane.

68. *Pleurotoma plicatella*, Hutton, "Trans. N.Z. Inst." vol xviii.
Wanganui.

69. *Drillia maorum*, Smith, "Ann. and Mag. Nat. Hist.," series 4, vol. xix., p. 497.
Petane.

70. *Drillia lævis*, Hutton, "Cat. Marine Moll. of N.Z.," p. 12.
Petane; Shakespeare Cliff.

71. *Drillia alabaster*, Reeve, "Pro. Zool. Soc.," 1843, p. 181.
Wanganui; Matapiro. Found living in Australia.

72. *Drillia wanganuiensis*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 4.
Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system. Much like *P. subæqualis*, Sowb., in Darwin's "Observations on the Geology of S. America."

73. *Drillia æquistriata*, Hutton, "Trans. N.Z. Inst.," vol. xviii.
Petane.

74. *Drillia protensa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 317 (*Daphnella*).
Petane.

75. *Daphnella lymneiformis*, Kiener, *Pleurot.* 62, t. 22, f. 3.
Shakespeare Cliff.

76. *Daphnella striata*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 5 (*Bela*).
Petane; Shakespeare Cliff. Found also in the Pareora system.

77. *Daphnella lacunosa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 317.
Shakespeare Cliff.

78. *Clathurella dictyota*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 316, pl. 18, f. 8.
Wanganui; Petane.

79. *Clathurella sinclairi*, Smith, "Ann. and Mag. Nat. Hist.," series 5, vol. xiv., p. 320.
Wanganui; Petane; Shakespeare Cliff.

80. *Clathurella hamiltoni*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 316, pl. 18, f. 7.
Petane; Matapiro; Wanganui (small variety).

81. *Clathurella abnormis*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 316.
Petane.

82. *Triton spengleri*, Lamarck, "Anim. sans Vert., ed. 2, vol. ix., p. 627.
Wanganui. Found also in the Pareora system.

83. *Cassis pyrum*, Lamarck, "Anim. sans Vert.," ed. 2, vol. x., p. 33.
Wanganui; Shakespeare Cliff.

84. *Natica neozelanica*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. ii., p. 237, pl. 66, f. 11, 12.
Wanganui; Kaimatera; Patea; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

85. *Natica gibbosa*, Hutton, "Trans. N.Z. Inst.," vol. xviii.
Matapiro. A single specimen, found by Mr. Hamilton.

86. *Natica ovata*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 9.
Wanganui; Patea. Found also in the Pareora system.

87. *Natica australis*, Hutton, (*Luvatia*), "Jour. de Conch.," vol. xxvi., p. 23.
Wanganui; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

88. *Natica vitrea*, Hutton, "Cat. Marine Moll. of N.Z.," p. 21.
Shakespeare Cliff.

89. *Natica lævis*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 317, pl. 18, f. 10.
Petane; Shakespeare Cliff.

90. *Sigaretus undulatus*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 318, pl. 18, f. 11.
Petane; Shakespeare Cliff.

91. *Sigaretus cinctus*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 318, pl. 18, f. 12.
Wanganui.

92. *Eulima treadwelli*, Hutton; *E. micans*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 318; not of Tenison-Woods.
Wanganui.

93. *Eulima media*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 318, pl. 18, f. 13.
Wanganui.

94. *Turbonilla neozelanica*, Hutton, "Cat. Marine Moll. of N.Z.," p. 22 (*Chemnitzia*).
Wanganui; Petane.

95. *Eulimella deplexa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 318.
Wanganui.

96. *Eulimella obliqua*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 318.
Petane.

97. *Aclis costellata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 319, pl. 18, f. 14.
Wanganui.

98. *Odostomia sulcata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 319, pl. 18, f. 15.
Wanganui; Shakespeare Cliff.

99. *Odostomia georgiana*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 319, pl. 18, f. 16.
Petane; Shakespeare Cliff.

100. *Odostomia lactea*, Angas, "Pro. Zool. Soc.," 1867, p. 112, pl. 13, f. 11.
Wanganui; Petane; Matapiro; Shakespeare Cliff.

101. *Odostomia fasciata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 320.
Wanganui.

102. *Odostomia sheriffii*, Hutton, "Trans. N.Z. Inst.," vol. xv., p. 411.
Wanganui.

103. *Odostomia rugata*, Hutton; *O. plicata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 319, pl. 18, f. 17; not of Montfort.
Wanganui; Petane. Found also in the Pareora system.

104. *Trivia neozelanica*, Kirk, "Trans. N.Z. Inst.," vol. xiv., p. 409.
Petane; Matapiro.

105. *Cancellaria trailli*, Hutton, "Cat. Marine Moll. of N.Z.," p. 26.
Wanganui; Petane.

106. *Cancellaria lacunosa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 320.
Petane.

107. *Admete ambigua*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 320, pl. 18, f. 18.
Wanganui.

108. *Trichotropis inornata*, Hutton, "Cat. Marine Moll. of N.Z., p. 26.
Petane; Matapiro; Shakespeare Cliff.

109. *Cerithium cancellatum*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 12.
Petane; Shakespeare Cliff. Found also in the Pareora system.

110. *Bittium terebelloides*, Martens, "Critical List of N.Z. Moll.," p. 26.
Wanganui; Petane.

111. *Bittium cinctum*, Hutton, "Trans. N.Z. Inst.," vol. xviii.
Wanganui; Petane.

112. *Cerithidea bicarinata*, Gray, in "Dieff. N.Z.," vol. ii., p. 241.
Wanganui; Kaimatera; Patea; Napier; Matapiro.

113. *Cerithidea tricarinata*, Hutton, "N.Z. Journal of Science," vol. i., p. 477.
Petane; Matapiro.

114. *Struthiolaria papulosa*, Martyn, "Univ. Conch.," pl. 54.
Wanganui; Shakespeare Cliff.

115. *Struthiolaria frazeri*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 329.
Matapiro. Found also in the Pareora system.

116. *Struthiolaria vermis*, Martyn, "Univ. Conch.," pl. 53.
Wanganui; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

117. *Struthiolaria cingulata*, Zittel, "Reise der *Novara*," Palæ., p. 35, taf. xv., f. 2.
Patea. A single specimen, collected by Mr. Buchanan. Found also in the Pareora system.

118. *Trochita neozelanica*, Lesson, "Voy. *Coquille*," Zool., vol. ii., p. 395.
Wanganui; Kaimatera; Patea; Napier; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

119. *Trochita inflata*, Hutton, "Trans. N.Z. Inst.," vol. xv., p. 411.
Wanganui; Kaimatera; Shakespeare Cliff.

120. *Trochita scutum*, Lesson, "Voy. *Coquille*," Zool., vol. ii., p. 395.
Wanganui; Petane; Matapiro; Shakespeare Cliff; Kaimatera.

121. *Trochita alta*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 329.
Petane; Matapiro. Found also in the Pareora system.

123. *Crepidula costata*, Sowb., "Gen. Shells," f. 3.
Wanganui; Patea; Petane; Matapiro; Shakespeare Cliff.

124. *Crepidula monoxyla*, Lesson, "Voy. *Coquille*," Zool., vol. ii., p. 391.
Wanganui; Kaimatera; Patea; Napier; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

125. *Crepidula unguiformis*, Lamarck, "Anim. sans Vert.," ed. 2, vol. viii., p. 642.
Wanganui; Petane; Shakespeare Cliff. Found also in the Pareora system.

126. *Hipponyx uncinatus*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 14.
Shakespeare Cliff.

127. *Turritella rosea*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 136, pl. 55, f. 24–26.
Wanganui; Kaimatera; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

128. *Turritella ambulacrum*, Sowb., in Darwin's "Geol. Obs. on S. America," p. 257, pl. 3, f. 49; *T. bicincta*, Hutton, "Cat. Tert. Moll.," p. 13.
Petane; Matipiro. Found also in the Pareora system.

129. *Turritella tricincta*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 13.
Wanganui; Kaimatera; Petane; Matapiro; Shakespeare Cliff. Found also in the Pareora system.

130. *Turritella pagoda*, Reeve, "Conch. Icon.," f. 60.
Wanganui; Shakespeare Cliff. Found also in the Pareora system.

131. *Eglisia planostoma*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 320, pl. 18, f. 19.
Wanganui; Petane.

132. *Rissoa emarginata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 320, pl. 18, f. 20.
Wanganui; Petane.

133. *Rissoa semisulcata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 231.
Wanganui; Petane.

134. *Rissoa rugosa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 231.
Petane.

135. *Rissoa impressa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 231.
Petane.

136. *Rissoa annulata*, Hutton, "N.Z. Journal of Science," vol. ii., p. 173.
Wanganui; Petane.

137. *Rissoa gradata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 321, pl. 18, f. 21.
Wanganui; Petane.

138. *Rissoa rugulosa*, Hutton, "Cat. Marine Moll. of N.Z.," p. 28.
Petane.

139. *Potamopyrgus corolla*, Gould, "Pro. Bost. Soc. Nat. Hist.," vol. ii.
Matapiro.

140. *Potamopyrgus antipodus*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 241.
Matapiro.

141. *Risella melanostoma*, Gml., in Linné's "Syst. Nat.," ed. 13, p. 3581, No. 90.
Wanganui; Kaimatera.

142. *Vermetus moniliferus*, "Hutton, Cat. Tert. Moll. of N.Z.," p. 13.
Shakespeare Cliff. Found also in the Pareora system.

143. *Vermetus neozelanicus*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 293.
Shakespeare Cliff.

144. *Xenophora conchiliophora*, Born.
Petane. A doubtful determination. Found also in the Pareora system.

145. *Scalaria zelebori*, Frauenfeld, "Reise der *Novara*," Moll., pl. 1, f. 6; *S. intermedia*, Hutton, "Cat. Tert. Moll. of N.Z.," p. 10.
Wanganui; Petane; Shakespeare Cliff. Found also in the Pareora system.

146. *Scalaria nympha*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 321.
Petane.

147. *Scalaria* (?) *corulum*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 322, pl. 18, f. 22.
Wanganui.

148. *Turbo smaragdus*, Martyn, "Univ. Conch.," pl. 73, 74.
Napier.

149. *Turbo granosus*, Martyn, "Univ. Conch.," *Trochus*, pl. 37.
Wanganui.

150. *Imperator imperialis*, Chemnitz, "Conch. Cab.," vol. v., p. 13, f. 1714, 1715.
Wanganui; Shakespeare Cliff.

151. *Rotella neozelanica*, Hombron and Jacquinot, "Voy. Pole Sud," Zool. v., p. 53, pl. 14, f. 5, 6.
Wanganui; Kaimatera; Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

152. *Trochus viridis*, Gml., from Chemn. "Conch. Cab.," vol. v., f. 1643, 1644.
Wanganui.

153. *Trochus conicus*, Hutton, "Trans. N.Z. Inst.," vol. xv., p. 411.
Shakespeare Cliff.

154. *Trochus tiaratus*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 256, pl. 64, f. 6–11.
Wanganui; Kaimatera; Shakespeare Cliff; Petane; Matapiro.

155. *Trochus chathamensis*, Hutton, "Cat. Marine Moll. of N.Z.," p. 36.
Wanganui.

156. *Zizyphinus decarinatus*, Perry, "Conch.," *Trochus*, pl. 47, f. 2.
Wanganui.

157. *Zizyphinus ponderosus*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 322.
Wanganui.

158. *Zizyphinus selectus*, Chemnitz, "Conch. Cab.," vol. xi., f. 1896, 1897.
Kaimatera; Shakespeare Cliff; Petane.

159. *Zizyphinus hodgei*, Hutton, "Trans. N.Z. Inst.," vol. vii., p. 458, and fig.
Shakespeare Cliff; Petane; Matapiro.

160. *Zizyphinus punctulatus*, Martyn, "Univ. Conch.," pl. 37.
Shakespeare Cliff; Petane. Found also in the Pareora system.

161. *Cantharidus tenebrosus*, Adams, "Pro. Zool. Soc," 1851, p. 170.
Shakespeare Cliff; Petane. Found also in the Pareora system.

162. *Cantharidus sanguineus*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 238 (*Gibbula*).
Wanganui; Petane.

163. *Cantharidus pupillus*, Gould, "Pro. Bost. Soc. Nat. Hist.," vol. iii., p. 91.
Shakespeare Cliff; Petane.

164. *Monilea egena*, Gould, "Pro. Bost. Soc. Nat. Hist.," vol. iii., p. 84 (*Solarium*).
Wanganui; Kaimatera; Shakespeare Cliff; Petane; Matapiro.

165. *Monodonta æthiops*, Gmelin, after Chemnitz, "Conch. Cab.," vol. v., f. 1820–1.
Wanganui; Kaimatera.

166. *Monodonta melaloma*, Menke, "Moll. Novæ Holl.," No. 50., p. 14.
Wanganui.

167. *Monodonta sulcata*, Wood.
Wanganui.

168. *Monodonta subrostrata*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 238.
Petane.

169. *Cyclostrema obliquata*, Hutton, "Trans. N.Z. Inst.," vol. xviii.
Wanganui.

170. *Scissurella mantelli*, Woodward, "Pro. Zool. Soc.," 1859, p. 202, pl. 46.
Petane.

171. *Haliotis rugoso-plicata*, Chemnitz, "Conch. Cab.," vol. x., p. 311.
Matapiro.

172. *Fissurella monilifera*, Hutton, "Cat. Marine Moll. of N.Z.," p. 42.
Shakespeare Cliff; Petane.

173. *Emarginula striatula*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 332, pl. 68, f. 21, 22.

Wanganui; Kaimatera; Shakespeare Cliff; Petane. Found also in the Pareora system.

174. *Parmophorus intermedius*, Reeve, "Pro. Zool. Soc.," 1842, p. 50.

Shakespeare Cliff; Petane; Matapiro.

175. *Acmæa corticata*, Hutton, "Man. N.Z. Moll.," p. 89.

Wanganui.

176. *Acmæa flammea*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 354, pl. 71, f. 15–24.

Shakespeare Cliff; Petane.

177. *Chiton pellis-serpentis*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 381, pl. 74, f. 17–22.

Shakespeare Cliff.

178. *Acanthochiton neozelanica*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 400, pl. 73, f. 5–8.

Petane.

SCAPHOPODA.

179. *Dentalium conicum*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 1.

Wanganui; Shakespeare Cliff; Patea; Petane. Found also in the Pareora system.

180. *Dentalium nanum*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 1.

Shakespeare Cliff; Petane; Matapiro.

181. *Dentalium ecostatum*, Kirk, "Trans. N.Z. Inst.," vol. xiii., p. 306.

Shakespeare Cliff; Petane. Found also in the Pareora system.

LAMELLIBRANCHIATA.

182. *Barnea similis*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 254.

Matapiro; Kaimatera.

183. *Pholadidea tridens*, Gray, in "Dieffenbach N.Z.," vol. ii. p. 254.

Wanganui.

184. *Saxicava australis*, Lamarck, "Anim. sans Vert.," 2nd ed., vol. v., p. 153.

Petane.

185. *Panopæa neozelanica*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 547, pl. 83, f. 7–9.
Wanganui; Petane; Matapiro. Found also in the Pareora system.

186. *Corbula erythrodon*, Lamarck, "Anim. sans Vert.," 2nd ed., vol. vi., p. 138.
Wanganui; Shakespeare Cliff; Petane; Matapiro; Kaimatera.

187. *Corbula neozelanica*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 511, pl. 85, f. 12–14.
Wanganui.

188. *Anatina angasi*, Sowerby.
Shakespeare Cliff.

189. *Thracia vitrea*, Hutton, "Cat. Marine Moll. of N.Z.," p. 61; *T. granulosa*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 19.
Wanganui.

190. *Myodora striata*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 537, pl. 83, f. 10.
Wanganui; Shakespeare Cliff; Petane.

191. *Myodora neozelanica*, Smith, "Pro. Zool. Soc.," 1880, p. 584, pl. 53, f. 5.
Wanganui.

192. *Myodora subrostrata*, Smith, "Pro. Zool. Soc.," 1880, p. 584, pl. 53, f. 6.
Wanganui. Found also in the Pareora system.

193. *Myodora antipoda*, Smith, "Pro. Zool. Soc.," 1880, p. 585, pl. 53, f. 7.
Shakespeare Cliff.

194. *Myodora boltoni*, Smith, "Pro. Zool. Soc.," 1880, p. 585, pl. 53, f. 9.
Matapiro.

195. *Mactra discors*, Gray, "Mag. Nat. Hist.," 1837, p. 371.
Wanganui; Shakespeare Cliff; Patea; Matapiro. Found also in the Pareora system.

196. *Mactra æquilatera*, Deshayes, "Pro. Zool. Soc.," 1853, p. 17; *M. elegans*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 19 (juv.)

197. *Mactra scalpellum*, Deshayes, "Pro. Zool. Soc.," 1854, p. 335.
Wanganui; Petane.

198. *Mactra lavata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 321.
Petane.

199. *Hemimactra notata*, Hutton, "Cat. Marine Moll. of N.Z.," p. 64.
Wanganui; Petane.

200. *Hemimactra elongata*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 518, pl. 83, f. 1, 2; *M. inflata*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 18.
Petane. Found also in the Pareora system.

201. *Hemimactra ovata*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 251; *M. rudis*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 19.
Wanganui; Shakespeare Cliff; Patea; Kaimatera.

202. *Hemimactra crassa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 322.
Wanganui.

203. *Lutraria solida*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 19.
Wanganui; Petane; Matapiro. Found also in the Pareora system.

204. *Cæcella neozelanica*, Deshayes, "Pro. Zool. Soc.," 1854, p. 335; *Darina pusilla*, Hutton, "Cat. Marine Moll. of N.Z.," p. 64.
Patea; Matapiro. Found also in the Pareora system.

205. *Zenatia acinaces*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 545, pl. 83, f. 5, 6.
Wanganui; Shakespeare Cliff; Patea; Petane. Found also in the Pareora system.

206. *Paphia neozelanica*, Chemnitz (*Mya*), "Conch. Cab.," vol. vi., f. 19, 20.
Wanganui; Shakespeare Cliff; Petane; Matapiro; Kaimatera. Found also in the Pareora system.

207. *Paphia ventricosa*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 252.
Kaimatera.

208. *Paphia spissa*, Reeve, "Conch. Icon.," *Mesodesma*, f. 18.
Wanganui; Kaimatera.

209. *Psammobia stangeri*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 253.
Wanganui; Petane; Matapiro. Found also in the Pareora system.

210. *Psammobia lineolata*, Gray, in "Yate's N.Z.," p. 309.
Wanganui; Patea; Matapiro. Found also in the Pareora system.

211. *Hiatula incerta*, Reeve, "Conch. Icon.," *Soletellina*, f. 13.
Matapiro. Found also in the Pareora system.

212. *Tellina alba*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 500, pl. 81, f. 1–3.
Wanganui. Found also in the Pareora system.

213. *Tellina glabrella*, Deshayes, "Pro. Zool. Soc.," 1854, p. 366.
Wanganui; Shakespeare Cliff; Kaimatera.

214. *Tellina disculus*, Deshayes, "Pro. Zool. Soc.," 1854, p. 360.
Wanganui; Shakespeare Cliff; Petane; Matapiro.

215. *Tellina subovata*, Sowerby, in "Conch. Icon.," f. 166.
Wanganui; Petane.

216. *Tellina angulata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 322.
Wanganui.

217. *Tellina retiaria*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 322.
Shakespeare Cliff.

218. *Venus oblonga*, Hanley, in Wood's "Index Test.," Supp.
Wanganui; Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

219. *Venus yatei*, Gray, in "Yate's N.Z.," p. .
Wanganui; Petane; Matapiro.

220. *Venus stutchburyi*, Gray, in Wood's "Index Test." Supp.
Wanganui; Petane; Matapiro; Kaimatera. Found also in the Pareora system.

221. *Venus meridionalis*, Sowb., in Darwin's "Geol. Obs. on S. America," p. 250, pl. 2, f. 13; *V. vellicata*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 21.
Petane; Found also in the Pareora system.

222. *Venus mesodesma*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 532, pl. 84, f. 17, 18.
Wanganui; Shakespeare Cliff; Patea; Matapiro; Kaimatera. Found also in the Pareora system.

223. *Venus sulcata*, Hutton, "Trans. N.Z. Inst.," vol. vii., p. 458, and fig.
Shakespeare Cliff; Matapiro. Found also in the Pareora system. Probably a large variety of the last species.

224. *Venus gibbosa*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 21.
Wanganui; Shakespeare Cliff. Probably another variety of *V. mesodesma*.

225. *Cytherea assimilis*, Hutton, (*Chione*), "Cat. Tertiary Moll. of N.Z.," p. 21.
Wanganui; Shakespeare Cliff. Found also in the Pareora system.

226. *Cytherea multistriata*, Sowb., "Thes. Conch.," vol. i., p. 628, pl. 36, f. 177.
Wanganui; Shakespeare Cliff; Petane. Found also in the Pareora system.

227. *Dosinia australis*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 249.
Shakespeare Cliff; Patea; Matapiro.

228. *Dosinia subrosea*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 249.
Wanganui; Shakespeare Cliff; Patea; Matapiro. Found also in the Pareora system.

229. *Dosinia grayi*, Zittel, "Reise der *Novara*," Palæ., p. 45, taf. xv., f. 11.
Wanganui; Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

230. *Dosinia limbata*, Gould, "Pro. Bost. Soc. Nat. Hist.," vol. iii., p. 277.
Wanganui; Shakespeare Cliff. Found also in the Pareora system.

231. *Tapes intermedia*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 526, pl. 84, f. 9, 10.
Wanganui; Petane; Matapiro. Found also in the Pareora system.

232. *Cardium striatulum*, Sowerby, "Pro. Zool. Soc.," 1840.
Wanganui; Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

233. *Chamostræa albida*, Lamarck, "Anim. sans Vert.," 2nd ed., vol. vi., p. 585.
Shakespeare Cliff. Found also in the Pareora system.

234. *Lucina dentata*, Wood, "Gen. Conch.," p. 195, pl. 46, f. 7.
Wanganui; Shakespeare Cliff; Patea; Petane; Matapiro. Found also in the Pareora system.

235. *Loripes concinna*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 323.
Shakespeare Cliff; Petane. Found also in the Pareora system.

236. *Mysia ampla*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 323.
Wanganui.

237. *Mysia neozelanica*, Gray, in "Dieffenbach's N.Z.," vol. ii. p. 256.
Wanganui; Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

238. *Mysia globularis*, Lamarck, "Anim. sans Vert.," 2nd ed., vol. vi., p. 231.
Wanganui.

239. *Kellia robusta*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 323.
Petane.

240. *Kellia effossa*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 323.
Petane.

241. *Cardita australis*, Lamarck, "Anim. sans Vert.," 2nd ed., vol. vi., p. 383.
Wanganui; Shakespeare Cliff; Petane; Matapiro; Kaimatera. Found also in the Pareora system.

242. *Cardita difficilis*, Deshayes, "Pro. Zool. Soc.," 1852, p. 103, pl. 17, f. 16, 17; *V. intermedia*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 24.
Wanganui; Petane; Matapiro. Found also in the Pareora system.

243. *Cardita patagonica*, Sowb., in Darwin's "Geol. Obs. in S. America," p. 251, pl. 2, f. 17; *V. intermedia* var. *B.*, Hutton, "Cat. Tert. Moll. of N.Z.," p. 24.
Petane; Matapiro. Found also in the Pareora system.

244. *Mytilicardia tasmanica*, Ten.-Woods, "Pro. Roy. Soc. Tasmania," 1875, p. 161.
Shakespeare Cliff; Kaimatera.

245. *Mytilicardia trigonopsis*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 324.
Wanganui; Petane.

246. *Nucula nitidula*, Adams, "Pro. Zool. Soc.," 1856, p. 51.
Wanganui; Shakespeare Cliff; Petane; Kaimatera.

247. *Leda concinna*, Adams, "Pro. Zool. Soc.," 1856, p. 48.
Wanganui.

248. *Leda fastidiosa*, Adams, "Pro. Zool. Soc.," 1856, p. 49; *L. semiteres*, Hutton, "Trans. N.Z. Inst.," vol. ix., p. 598.
Petane. Found also in the Pareora system.

249. *Solenella australis*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 471, pl. 78, f. 5–10; *Nucula ornata*, Sowb., in Darwin's "Geol. Obs. in S. America," p. 251, pl. 2, f. 19.
Petane. Found also in the Pareora system.

250. *Arca decussata*, Sowerby, "Pro. Zool. Soc.," 1833, p. 18.
Wanganui; Shakespeare Cliff; Petane; Kaimatera. Found also in the Pareora system.

251. *Macrodon* (*Scaphula*?) *lanceolata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 332.
Petane.

252. *Cucullæa attenuata* (?), Hutton, "Cat. Tertiary Moll. of N.Z.," p. 28.
Patea. Found also in the Pareora system.

253. *Pectunculus laticostatus*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 466, pl. 77, f. 4–6, and 1, 2.
Wanganui; Shakespeare Cliff; Patea; Petane; Matapiro. Found also in the Pareora system.

254. *Pectunculus striatularis*, Lamarck, "Anim. sans Vert.," 2nd ed., vol. vi., p. 493.
Wanganui; Petane; Matapiro.

255. *Mytilus magellanicus*, Lamarck, "Anim. sans Vert.," 2nd ed., vol. vii., p. 37.
Wanganui; Shakespeare Clift; Petane. Found also in the Pareora system.

256. *Mytilus latus*, Chemnitz, "Conch. Cab.," vol. viii., f. 747.
Shakespeare Cliff; Petane; Matapiro.

257. *Modiola australis*, Gray, in "King's Voyage," vol. ii., p. 477.
Wanganui; Shakespeare Cliff; Matapiro. Found also in the Pareora system.

258. *Crenella impacta*, Hermann; Reeve, "Conch. Icon.," *Modiola*, f. 64.
Shakespeare Cliff; Petane.

259. *Lithodomus striatus*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 26.
Shakespeare Cliff. A single specimen, collected by Mr. Buchanan.

260. *Perna*, sp. ind.
Petane; Matapiro. Found also in the Pareora system at Castle Point.

261. *Pinna neozelanica*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 259.
Wanganui; Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

262. *Lima crassa*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 33; *L. zealandica*, Sowb., "Pro. Zool. Soc.," 1876, p. 754.
Wanganui; Shakespeare Cliff; Kaimatera. Found also in the Pareora system.

263. *Lima angulata*, Sowb., "Thes. Conch.;" Reeve, "Conch. Icon.," f. 13.
Wanganui; Shakespeare Cliff.

264. *Lima bullata*, Born.; Sowb., "Thes. Conch.," vol. i., p. 22, f. 33.
Shakespeare Cliff; Petane.

265. *Pecten semiplicatus*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 30.
Napier. Found also in the Pareora system at Castle Point.

266. *Pecten laticostatus*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 250.
Wanganui; Shakespeare Cliff; Petane.

267. *Pecten neozelanicus*, Gray, in "Dieffenbach's N.Z.," vol. ii., p. 260.
Wanganui; Shakespeare Cliff; Petane; Matapiro; Kaimatera. Found also in the Pareora system.

268. *Pecten triphooki* (?), Zittel, "Reise der *Novara*," Palæ., p. 52, pl. xi., f. 4.
Moteo, near Puketapu. Found also in the Pareora system.

269. *Pecten radiatus*, Hutton, "Cat. Marine Moll. of N.Z.," p. 82.
Wanganui; Shakespeare Cliff; Petane. Perhaps a variety of the last.

270. *Pecten convexus*, Quoy and Gaimard, "Voy. *Astrolabe*," Zool. iii., p. 443, pl. 76, f. 1–3.
Wanganui; Shakespeare Cliff; Petane, Matapiro. Found in the Pareora system at Castle Point.

271. *Anomia alectus*, Gray, "Pro. Zool. Soc.," 1849, p. 117.
Wanganui; Shakespeare Cliff; Petane. Found also in the Pareora system.

272. *Anomia undata*, Hutton, "Trans. N.Z. Inst.," vol. xvii., p. 324.
Petane. Found also in the Pareora system.

273. *Anomia stowei*, Hutton, "Cat. Marine Moll. of N.Z.," p. 83.
Petane; Matapiro.

274. *Ostrea edulis*, Linné.
Wanganui; Shakespeare Cliff; Petane; Matapiro. Found also in the Pareora system.

275. *Ostrea corrugata*, Hutton, "Cat. Tertiary Moll. of N.Z.," p. 35.
Shakespeare Cliff. A single specimen, collected by Mr. Buchanan.

BRACHIOPODA.

276. *Waldheimia lenticularis*, Deshayes, "Mag. Zool.," 1841, t. 41.
Wanganui. Found also in the Pareora system.

277. *Waldheimia ovalis*, Hutton, "Trans. N.Z. Inst.," vol. xviii.
Shakespeare Cliff; Napier. Found also in the Pareora system at Castle Point.

278. *Terebratella cruenta*, Dillwyn; Reeve, "Conch. Icon.," f. 20.
Shakespeare Cliff.

279. *Terebratella rubicunda*, Solander; Reeve, "Conch. Icon.," f. 27.
Shakespeare Cliff; Petane; Kaimatera. Found also in the Pareora system.

280. *Rhynchonella nigricans*, Sowb., "Thes. Conch.," vol. i., p. 342.
Wanganui; Shakespeare Cliff; Petane; Kaimatera. Found also in the Pareora system.

Art. LVIII.—*On the Age of the Napier Limestones.*

By A. McKay.

[*Read before the Wellington Philosophical Society, 21st October,* 1885.]

The late Dr. von Hochstetter, basing his expressed opinion upon material supplied him by Mr. Triphook and others, referred all the beds in Scinde Island to the upper part of his Hawke's Bay series.

This Hawke's Bay series of Hochstetter is by him referred to the upper division of tertiary deposits in New Zealand, as determined by him, and called "younger tertiary formations." These embrace a triple series: the Awatere series; the Hawke's Bay series; and the Wanganui series. How these are related to each other we are not distinctly told; but it is evident that the terms are not geographical distinctions for equivalent formations in different districts, and that the Hawke's Bay series was considered intermediate in age between the Awatere and Wanganui series.

In the Geological Reports for the year 1868–69, Captain Hutton recognises the existence of the "Hawke's Bay series," and refers to it the beds forming the Mahia Peninsula, and a large district N.E. and S.W. of Poverty Bay. Dr. von Hochstetter had previously referred the beds forming Mahia Peninsula to the Hawke's Bay series, so that there is no doubt that Captain Hutton meant the Hawke's Bay series of Hochstetter. His estimate on the age of these beds is expressed elsewhere, in a paper on "The Artesian Wells near Napier," in which he describes the rocks forming Scinde Island as belonging to a formation "of late tertiary date."

Dr. Hector, in the "Geological Reports" for 1870–71, describing the geology of the Hawke's Bay District, makes use of the term "Hawke's Bay series" for the same rocks as those described by Hochstetter, and quotes from Hochstetter to show that the beds belong to the "latest tertiary formation." Dr. Hector traced the beds north and north-west from Petane to Pohui, and as outliers, further north, beyond the Mohaka River. He referred the Te Aute limestone to the Hawke's Bay series. This had been done by Captain Hutton on the 12th September, 1870.

Thus, to the middle of 1871, there appears to have been no question as to the "late tertiary age" of the Hawke's Bay series, nor as to the conformable relations of all the beds ascribed to it. Next year (5th November, 1872) was published Captain Hutton's "Synopsis of the Younger Formations of New Zealand." and of this, the "Hawke's Bay group" was referred to the oligocene period. This Hawke's Bay group is typically represented by the same locality as that of the "Hawke's Bay series" of Hochstetter, viz., "Napier," but other and distant localities are added, and rock formations of a class and age never contemplated by Hochstetter. The result of this inclusion of strata older than the Awatere series of Hochstetter, was to lower the percentage of recent species found fossil in the beds to 20 per cent.; and, as a consequence, the reference of the Hawke's Bay group to a much earlier period than the Hawke's Bay series had been referred to. How far the two should be considered identical may be inferred, and remains to be seen.

In 1873, Captain Hutton suppressed the name "Hawke's Bay group," and substituted "Ahuriri formation" in its place, and, describing its fossils, considered that 23 per cent. of its mollusca and echinodermata were recent species. The Hawke's Bay group or Ahuriri formation was now referred to the lower miocene period.

In June, 1875, the same beds were, by Captain Hutton, referred to the middle miocene period.

On the 4th of January, 1875, I divided the tertiary strata of Hawke's Bay District into Lower or Hawke's Bay series, and Upper or Wanganui series, including the shelly limestones of Napier with the lower group or series. During the early part of 1876, Mr. Cox examined the country between Poverty Bay and Napier, and determined the tertiary rocks of the district as a single sequence, to which, however, he assigned no particular period, eocene or pliocene. He considered the Napier limestone to be near the base of the series, although his statements are somewhat incompatible with the assumed conformity of the whole series of tertiary beds described by him. Dr. Hector at the time considered the higher beds described by Mr. Cox as belonging to the same horizon as the Upper Wanganui beds.

During November of the same year, Mr. S. Percy Smith read before the Auckland Institute a paper on the "Geology of the Northern portion of Hawke's Bay," and, like Mr. Cox, describes an upper and a lower limestone, separated by a great thickness of sands, clays, and conglomerates; all presumably of tertiary date.

In 1873, Captain Hutton rejected, as not belonging to the Ahuriri formation, the conglomerate sands and clays in the Cape Kidnappers section, which are described by Hochstetter as the base of the Hawke's Bay series, the higher beds appearing at Scinde Island and at Petane. These beds were considered by Dr. Hector, when he examined the district in 1871, as occupying the position assigned them by Hochstetter. Captain Hutton considered them pleistocene, and later I spoke of them as belonging to the Wanganui series. The position of similar rocks, described by Mr. Cox and Mr. Percy Smith as underlying the limestones of Scinde Island and the coast to the northward, and the reference of these with the overlying shelly limestones, seemed to call for a revision of the Ahuriri series of Hutton. Other causes, however, brought this about at an earlier date than the publication ot Mr. Cox's report, which did not appear till 1877.

In a paper read before the Otago Institute on the 24th of October, 1876, Captain Hutton discusses the relation between the Pareora and Ahuriri formations; in which, referring to the classification of the tertiary formations of New Zealand in his "Catalogue of the Tertiary Mollusca and Echinodermata," speaking of the beds separated and grouped under one or other of these formations, he says: "I have been gradually led to doubt the correctness of this division, and to consider it probable that both ought to be regarded as one and the same formation." He now gives the proportion of recent species found in the Ahuriri formation as being 35 per cent., or, with the same number of species, 12 per cent. more than in 1873.

Early in 1877 I examined the country between Masterton and Napier; and in reporting on the geology of this district, I divided the tertiary rocks as I had previously done in 1875, referring the beds overlying the Te Aute limestone to the pliocene period, and the limestones W. and N.W. of the Ahuriri Plain, and in Scinde Island, to the upper part of this higher series; and later, in August, 1878, I pointed out that these were unconformable to the Te Aute limestones. This had already been indicated by Dr. Hector as their probable relation, in his Progress Report for 1876–77.

On the 14th of January, 1885, there was read before the Geological Society of London "A Sketch of the Geology of New Zealand," by Captain Hutton. In this the author states that the grouping of the tertiary rocks is founded on that given in a former

communication to that Society, which was the same as the synopsis of the younger formations of New Zealand, published in the "Reports of the Geological Survey" for the year 1871–72. Captain Hutton, however, adds that the new classification includes modifications subsequently made. These, however, cannot affect the chronological arrangement of the different series or groups of strata, without at once destroying all semblance which the latter might have to the former classification; and we are compelled to take the different series included under the Pareora system as a chronological arrangement, and in the order in which they are stated. Those series, in descending order, are:—

1. Awatere series.
2. Kanieri series.
3. Tawhiti series.
4. Ahuriri series.
5. Waitemata series; and
6. The brown coals of the Pomahaka, etc.

The Awatere and Kanieri series, or groups, formerly constituted the Pareora formation, the Ahuriri formation being the next underlying. Now, however, we have between these the Tawhiti series; and it is manifest that Captain Hutton has abandoned the idea that the Ahuriri and Pareora formations are the same. If it is otherwise, he makes no distinction (stratigraphical or palæontological) between the Scinde Island limestones and the rocks forming the Taipos, on the east coast of Wellington, or the brown coal beds of the Pomahaka, in Otago; all the divisions being referred, not to the relative parts of a system of rock-formations, but to a single series, having strict equivalents in all the localities where rocks belonging to the Pareora system are present.

On the 2nd July last, Captain Hutton read, before the Philosophical Institute of Canterbury, a paper on the "Geology of Scinde Island," in which, for the first time, he describes the limestones present in Scinde Island, the lower of which he refers to the Ahuriri series of his last classification, and the upper to the Wanganui system and Petane series of the same. He says that the upper limestone, with the accompanying underlying sandy beds, is unconformable to the lower limestones, and shows them highly so in the section which accompanies his paper. It is further said that the lower limestone is the equivalent of the Te Aute limestone, which is also stated to be the equivalent of the Pohui limestone of Te Waka. Of the 24 species of fossil shells collected from the lower or Ahuriri limestone, 15, or 61 per cent., are noted as recent species; and we must remember that the original Hawke's Bay group was supposed to contain no more than 20 per cent. of recent shells.

During the 5th, 6th, and 7th September last I examined Scinde Island, and agree with Captain Hutton that there is an upper and a lower limestone in Scinde Island, but saw no reason to suppose that these were unconformable to each other. To me, the evidence was quite clear that the lower limestones and overlying sands are connected by passage beds, and shade into one another. I further found that, not the northern, but the western side of Scinde Island showed the presence of the younger series; and I could not arrive at the conclusion that the lower beds are the equivalents of the Te Aute limestone, nor of any formation containing no more than 35 per cent. of recent species. The upper beds, I admit, resemble the shell limestones of the mainland to the W. and N.W. of the Ahuriri Plain, but I was forced to the conclusion that either the upper limestones are not the same as those on the mainland already mentioned, or that the lower limestone was not the Te Aute limestone, and in all these conclusions differ from the opinions of Captain Hutton.

To try to solve the various problems thus requiring to be considered, I went to Petane, and thence by coach to the Mohaka Valley, spending two days to the west and north of the river-crossing, and the other available day on the Te Waka Range; the sequence to the eastward I but partly observed. I traced the tertiary sequence, as here represented, to its base in the Kiwi Range, and further to the north along the Taupo Road. I found strata rich in fossils in this direction, on the north-western side of this part of the Mohaka Valley, and was able thus to refer nearly a thousand feet of strata to the Pareora series of the Geological Survey classification.

The fossils of this part of the tertiary sequence are abundant in the Mohaka river-bed, near the bridge and crossing of the Taupo Road; but I did not content myself with these, but sought out the fossiliferous beds in section.

These lower beds are characteristic, and not difficult to be distinguished from those that over-lie on the south-east side of the valley. They are brown, green, or grey sands, or fine grit, with concretions or beds of harder and more calcareous material full of shells. In their upper part, the brown sands alternate with lighter-coloured sandy clays. They dip a little to the S. of E. at moderate angles, 20° to 25°. Eastward of the Mohaka these are followed conformably by a great thickness, more than 1,000 feet, of light-grey sandy beds of a more argillaceous type than the last brown sand bed appearing in the Mohaka east bank, at the crossing. This series is closed by a bed of brown sand of considerable thickness, which shows on the western brow of the Titiokura saddle, by which the Napier-Taupo Road reaches the Mohaka. These appear to be the gritty sandstones, "No. 9," of Mr. Percy Smith's map, and the "grey and brown sandstones" of Captain Hutton. Fossils are rare, and I collected

none; but Captain Hutton mentions four species occurring in them, only one of which, *Struthiolaria tuberculata*, I found in the lower beds. I would refer these rocks to the Awatere series of the Geological Survey. They are conformably overlaid by the Pohui limestone. This is a thick band of coarse, shelly limestone, often loose calcareous sand, with harder bands at irregular distances, and not continuous, at least where the Taupo Road crosses it. Further to the S.W., on the Te Waka Range, it is perhaps 100 feet thick; and further to the S.W. appears to be much thicker. It abounds with fossil shells in the lower part; and in the upper part, not far from the Taupo Road, it is full of small corals. Further to the S.W., and S.E. of its disappearance on the road-line before reaching Pohui, this lower limestone is followed by argillaceous sands of about the same thickness as those seen between the two limestones in Scinde Island, and these are followed by a second limestone, as in Scinde Island. It is this upper limestone that forms the peculiar cubical, castellated feature of Te Waka itself, the inferior limestone forming the western scarp of the range, and separated from the upper as already stated.

The lower limestone, however, shows in the scarp, running nearly N. and S. at the back of Pohui, and finally disappears at Pohui Lake. The upper limestone, yet separated by the argillaceous sands spoken of, disappears half a mile to the S.E. at the first bridge on the road to Napier. This represents the section in Scinde Island; that is, the succession and character of the rocks are the same. The fossils have yet to be exhaustively collected before this can be finally determined.

The fossils I obtained are chiefly the larger *Pectens* found in the lower limestone in Scinde Island. They were specially sought for, as I was under the impression these would determine the age of the beds; but *Voluta pacifica*, *Pinna neozealanica*, *Pecten radiatus*, *Modiola areolata*, and *Waldheimia lenticularis*, were also collected, shells yet living, and not found lower than the limestone in Scinde Island. It further seemed to me that had an exhaustive collection been made, it would have been characterised by a very large percentage of recent species. It would, however, be unfair to add these recent species as occurring in the lower of the Scinde Island beds, and thus raise yet higher the percentage of recent species found in that limestone. This is already sufficiently high; but there seems some reason to suppose that, contrary to what Captain Hutton says is probable, further research will add to and not diminish this percentage; and I believe that two of the species mentioned do occur in the lower beds in Scinde Island.

I have not time, nor is it my present purpose, to discuss the probabilities of an unconformity in this line of section east of Pohui. I could not determine any such to be present. I

observed that the next rocks seen on the road-line, to the S.E. of the disappearance of the Upper Pohui limestone, were light grey sandy beds, very much resembling those seen to the N.W. of the Lower Pohui limestone on the fall from the Saddle into the Mohaka Valley, and these might be brought into this position by a fault or unconformity; but, were this so, the overlying brown sands and conglomerate would yet have to show evidence of unconformity, and I could discover none.

Further to the E. and S.E. the section has already been described by previous observers, and I need not here detail it.

Grey and brown sands and coarse sandstone conglomerates, pupa rock, and tufaceous sands, form a great series of strata before reaching the overlying shelly-limestones of Petane and the coast range to the N.E. of the Lower Esk. Between Pohui Lake and the coast there may be 2,000, 3,000, or even 4,000 feet of strata; its exact measure is not at present of importance, it being admitted on all hands that collectively there is a great thickness of strata, amounting to some thousands of feet. This, in some way, we have to consider represented in Scinde Island, and by not more than some 120 to 150 feet of strata. This is possible, but, considering the distance between the Esk Valley and Napier, barely probable.

Next we have to consider that the section from Puketapu, on the Tutaekuri River, back to the S.W. continuation of the Pohui limestone, shows no diminished thickness of the beds overlying the latter and underlying the Petane limestone, rendering it yet less probable that this great series can be represented a few miles off by so small a thickness as that of their supposed representatives in Scinde Island. Farther to the S.W., along the Ngaruroro River, from the limestone hills on the western border of the Ahuriri Plain to the lower end of the Ngaruroro Gorge, a yet greater thickness of these beds is developed; and let any one look from the offing in Hawke's Bay at the immense development of conglomerates, sands, and clays, that between Cape Kidnappers and the mouth of the Tukituki are present, and then consider that these must be fully represented in Scinde Island—if we are to regard the upper shelly limestones there the same as that found on the mainland at Petane; or, as an alternative, the lower limestones the same as the Te Aute limestone. And, in spite of liberal allowance in the way of thickening and thinning of the strata, the reasonable probabilities of the case will be, with most observers, that either the Petane limestones are not present, or, that the Te Aute limestones are absent. There is, however, a third possibility: but this has never yet suggested itself to any observer of the geology of the district, and I dare say will not now be entertained. This is: there may be a double unconformity in Scinde Island. Firstly, between the lower or supposed Te Aute limestones of Hutton; and, secondly,

between the Petane sands and the overlying shelly limestones, thus admitting of the reduction by denudation of the intervening beds down to the meagre thickness which they now present.

What may be the final conclusions respecting this stratigraphical difficulty I am not prepared to hazard an opinion. Meanwhile, I do not consider the upper miocene Te Aute limestone present in Scinde Island. The palæontological evidence brought forward by Captain Hutton is against this, and the evidence, as collections are added to, is likely to be strengthened rather than weakened; that is, if the Pohui limestone be the same as the lower limestone in Scinde Island, which it is asserted to be.

One difficulty in the way of regarding these rocks as of pliocene age has been the number and remarkable size of the extinct forms of *Pecten* found in them, which are not supposed to occur in the upper shelly limestones of admittedly pliocene age, and which occur also abundantly in the Te Aute limestone. This is by no means an insuperable difficulty, and we have only to consider them as exceptional, and in reality belonging to an older period. Looked at in that light, they would have to be excluded in arriving at the age of the beds, as determined by the percentage of living species; and were this done, all doubt of the pliocene age of the beds would be removed. There would then be 71 per cent. of recent species found in the beds. Were these *Pectens* retained, and the five recent species found at Pohui added to the 15 occurring in Scinde Island, we should have a like result—viz., nearly 70 per cent. of recent species from the limestones of this horizon.

From the Lower Wairarapa Valley, N.E., to the northern part of Hawke's Bay Provincial District, the Te Aute limestones everywhere close the middle tertiary sequence, as seen in this part of the North Island. The Pareora formation of Hutton, characterised by a proportion of recent species equal to 37 per cent., should, one would think, underlie the Te Aute limestones, at least ought to underlie its supposed representative in Scinde Island, with 61 or 70 per cent. of its species recent. And yet, if we accept Captain Hutton's latest classification, we are required to suppose that the Pareora beds, containing little more than half the number of living species, are actually the older series. The Te Aute limestone cannot be made to occupy this position relative to the Pareora series, without setting aside all the evidence obtainable, both palæontological and stratigraphical; but if regarded as the highest member of that series, this would be more in accord with what is known as to its actual position. It may be the lowest member of the young tertiary sequence; more probably, along the East Coast of the North Island it closes the middle tertiary series.

V.—ASTRONOMY.

ART. LIX.—*The Total Eclipse of the Sun of the 9th September, 1885; being a Digest of the following Communications to the Institute on the subject:—*

A.—On the Total Eclipse of the Sun, 9th September, 1885. By JOHN MEESON, B.A. Read before the Nelson Philosophical Society, 2nd November, 1885.

B.—On the Total Eclipse of the Sun, 9th, September 1885. By the Right Rev. Dr. SUTER, Bishop of Nelson. Read before the Nelson Philosophical Society, 2nd November, 1885.

C.—On the Total Eclipse of 9th September, 1885, as seen at Tahoraite. By JOHN GOODALL, M.I.C.E. Read before the Hawke's Bay Philosophical Institute, 14th September, 1885.

D.—On the Total Eclipse of the Sun, 9th September, 1885. By A. S. ATKINSON. Read before the Nelson Philosophical Society, 2nd November, 1885.

E.—On the Total Eclipse of the Sun, 9th September, 1885. By Dr. HUDSON. Read before the Nelson Philosophical Society, 2nd November, 1885.

F.—Observations on the Solar Eclipse of 9th September, 1885. By A. COLEMAN. Read before the Nelson Philosophical Society, 2nd November, 1885.

Plates XIV., XV., XVI.

[NOTE BY THE EDITOR.—The section of the moon's shadow, as it swept over the earth's surface, was in the shape of an ellipse, 190 miles in length by 90 miles in width. The only land crossed by the shadow was that part of New Zealand lying in the vicinity of Cook Strait, so that the total phases could only be observed there; the line of centrality sweeping in the shape of a curve from a point half-way between Australia and New Zealand, where the sun was rising at the time of totality, to a point between Cape Horn and the South Pole, latitude 75° S., where the sun was setting at

the time of the eclipse. In New Zealand, the line of centrality passed through West Wanganui, Collingwood, D'Urville Island, and the Wairarapa, leaving the land on the East Coast at Castle Point. At all places along the line of centrality, the duration of the total phase was computed at 1′ 58″, the time being a few seconds longer towards the east. At Castle Point, the totality commenced at 7h. 35m. 12s. a.m., New Zealand mean time; at Wellington, at 7h. 35m. 4s.; and at Nelson, at 7h. 34m. 14s. Observations of a more or less scientific nature were taken at a number of places—Tahoraite, Wairarapa, Manawatu, Wellington, Picton, Nelson, Collingwood, etc.; and a large number of papers and communications were made to the public press, and to various scientific societies, conveying the impressions of the various observers.

From a review of the observations that were made, the following conclusions were arrived at:—

"Scarlet prominences were only moderately developed, and were clustered chiefly at the equatorial and polar regions of the sun. The best observers agree that the corona had a very irregular outline, and was most continuous and vivid close to the sun's limb, having the longest expansion reaching to nearly two diameters from the western equatorial region. This large expansion appears to have had a strongly marked spirally twisted structure, while all the other appendages consisted of radiating pyramids. No laminated structures appear to have been observed in any part of the corona.

"Most observers agree in describing an intensely brilliant flash or meteor, lasting for two seconds, at the commencement of totality on the eastern side of the sun, and exactly over the position of a large sun-spot that was just coming into view at a few degrees south of the sun's equator. This flash is described as having looked like a large electric lamp suspended at a little distance from the moon's edge. At the close of totality another flash, similarly bright, but not so large and pointed, was seen on the western limb of the sun, in a position corresponding with a large sun-spot that was within 1′ of arc of passing over the sun's edge."*]

I.—General Description.

Mr. John Meeson, B.A., gives the following general description of the eclipse:—

"The weather was perfect, the sky almost, if not quite, cloudless, with a very light wind from the S.E.; a clear, moistureless, frosty air! My point of observation was my own garden at Woodstock, Stoke, whence, from 6.45 a.m., when the

* "Proc. Roy. Soc., London," 19th November, 1885, "On the Total Solar Eclipse of September 9," by Dr. Hector, F.R.S., dated 12th September, 1885.

sun—already partially obscured—rose from behind the north-eastern hills, until 8.30 a.m., by which time the moon had completely passed over the solar face, the view was continuous and uninterrupted. More perfect circumstances for making valuable observations cannot well be imagined; and a sight grander and more unique than the whole eclipse it is impossible to conceive. Even as the wind falls when the shades of evening close around, the very light breeze which had been blowing in the early morning gradually died away, and darkness increased. Birds ceased their twittering, all—at all events, except some paraquets, which were evidently much startled, and broke into the most noisy chattering as the sun disappeared, and flew away, it may be supposed, to their usual night haunts. Everything else became hushed; even the human voice had, or seemed to have, an unnatural sound. All nature seemed to bow its head, and stand in mute silence as the awful spectacle passed, and until the God of Day should again emerge from his temporary seclusion. The general appearance of things at the moment of totality, which was certainly not a period of complete darkness—for a soft and 'dim, religious light' was always present—was such as the observer can surely never forget. It was decidedly uncanny. The human face looked ghastly. The colours on mountain and field, on sea and sky, were weird, unearthly, and indescribable, such as one had never seen before. They had gradually deepened in hue as the eclipse proceeded, and just before totality the sky around the sun was of a dirty yellow, and quivering beams, of the colour of electric light, shot out from above and below the moon, giving it somewhat the appearance of a St. Andrew's cross with a circular centre.

"Generally speaking, during the sun's complete obscuration, the sky was of a mauve colour, except round about the luminary itself, where the intense brilliance of the silvery protuberances or the golden glory of the coronal rays diffused tints of dirty red and grey. The sea became black, the mountains across the bay iron-grey, while the sky above the latter assumed shades of dirty, ghastly yellow. A few patches of fleecy clouds hanging low over the sea took on the appearance of black cumulus heaps, and afterwards, on the emergence of the sun, donned garbs of varied colours. The lunar orb, during totality, stood out boldly, and round its limbs was a fine fringe of intense light, which glistened like diamonds; upon its surface a slight reflected light was clearly seen. After the eventful period of a minute and a few seconds had passed, there appeared, at the point of the moon's disc opposite to that which first obscured the sun—at the point, that is, where arose, as we shall afterwards see, the longest streamers of the corona and the highest prominences,—a growing effulgence of light, which rapidly intensified as we watched. The prominence seemed to swell and

bubble and boil like a spring of molten silver. This appearance was produced by the blending together of the large prominences and the sun's reappearing disc; and not for several seconds, perhaps, did the latter assert itself, assume its true shape, and, by its superior luminosity, cast the protuberance into obscurity, and substitute its ordinary beams for the temporary or temporarily-perceptible coronal rays. During the obscuration, stars were plainly seen by those whose attention was not already bespoken by something more unusual. I saw Jupiter very distinctly. The rushing of wind, as from all points of the compass, remarked upon by one of our local newspapers, I certainly did not experience. The fall of temperature along the belt of totality, instead of causing wind thitherwards, would rather operate to produce motion of the air in precisely the opposite direction. But, as already observed, there was really no wind at all, but over everything the stillness as of death."

The Bishop of Nelson describes the eclipse as observed from a hill near Nelson:—

"The *sensible* progress of the eclipse at first seemed slow, but at the critical and crucial moment it appeared cruelly rapid. The body of the moon crept on over the left or western limb of the sun, and while it was about half over, there was a very sensible diminution in the light. It began to be a cold and silvery light, and the absence of yellow light seemed more and more marked, till the not unfamiliar lunar crescent-shape was assumed by the sun; and this stage was the period of quite a peculiar phenomenon in the appearance of the hills below the sun. Each one of the many rough furrows of valleys, divided by ridges of bush, became dark and black in shade; but each ridge was distinctly marked by a yellowish-green light, so remarkable as to form the subject of notice by me to the bystanders, who all acquiesced in the recognition of the decided and noticeable peculiarity of the appearance. It was most marked, and fortunately so much so as to be capable of reproduction. Possibly there may be a somewhat similar appearance under the crescent moon.

"As totality came near, and one's attention was confined almost exclusively to the sun, it seemed to me that the crescent was divided into one or two elongated portions of light, and then, subsequently, that these elongated portions were divided up into what reminded me of the cogs of a wheel, or rather the little blocks of different metal that are planted in the rim of the compensating balance of a good watch or chronometer. I suppose this appearance to be that described as "Bailey's beads." They appeared to me to exist for only a very short time indeed, but they were distinct cogs of light, over little more than a third of the edge of the sun, on the eastern or lower side.

"It then appeared to me as if the sun, or dark body of moon,

were encircled with a brilliant ring at the time when, to use a common phrase, the sun "went out."

"This corona, or ring of light, had time just to print its impression on the eye when *two appearances* made themselves manifest: First, the body of the moon started into rotundity—or, if I may use the word, globosity—from two . . . into three, from being a black disc, into a faintly but decidedly luminous globe, the effect, we are told, of *earthshine* on its surface. Earthshine in its effects is decidedly less evident than moonshine. (The second appearance is dealt with under the heading 'Prominences.')

"The darkness was not exactly that of night. As to the degree of light, it seemed to be paralleled by the amount of light diffused about when the moon is nearly half full; but the light that remained on this occasion was not that of the blue silvery moonlight, but of a neutral character, and the darkness seemed to have a palpability, if so it can be called. At the latter part of totality I turned to pick up the binocular, which I had discarded for the plain smoked glass guard, and was surprised then at the actuality of the darkness. I turned round, and caught sight of what made me look again, and I experienced a sensation to which I can only apply the epithet appalling.

"The glorious sign in the heavens shone forth on a yellowish-grey sky, which shaded off on the distant horizon to brilliant yellow and orange; but in mid-air, to the north-west, rode in the air a bank of clouds, over which the conical shadow was passing. Light was visible on both sides of the band of the total shadow, and all objects within that range and near the darkness seemed to come up quite close to one; distance seemed annihilated. I felt as if this bank of clouds was quite close upon me. It was composed of towering cloud masses, standing out in stereoscopic solidity, blotched (as a painting) with rounded masses of purple, blue-black, and grey, and at the edges having bands of burnt sienna; under the clouds was the bright light I have mentioned."

Mr. John Goodall, M. Inst. C. E., observed the eclipse at Tahoraite, in the Forty-mile Bush. The following extracts are taken from his paper:—

"I went to Tahoraite on the afternoon of the 8th; the weather was not promising; there were repeated showers of rain, hail, and sleet up to two o'clock in the morning, ever, with any great hopes of being able to use it. By 6 a.m. but by five o'clock there was a fine clear frost, and scarcely a cloud in the sky, with every prospect of successful observations of the eclipse. I mounted my telescope, a $4\frac{1}{2}$-inch refractor, and attached a direct vision spectroscope to it—not, how-all was ready, and the telescope pointed to the eastern horizon, which was perfectly clear. Towards the south there was a

heavy bank of clouds rising, looking dangerous enough to mar the event of the day. A stray cloud creeps near to the path of the sun, becomes illuminated, changing colour rapidly, ending with the silver lining, and the sun appears above the dark, ragged line of the tops of the distant New Zealand bush, perfectly clear of clouds; as it rises, three bands of clouds cross its face. This ominous indication soon disappears, and the sun is in its full splendour, revealing to the telescope two large groups of sun spots and faculæ in its eastern and western limbs. A peculiar ruddy tint now appears over the sun, caused probably by cosmic dust or earth vapour. As the sun rises to about 10° this ruddy tint disappears, and we patiently await the first contact of the moon, the first indication of which is a roughening of the sun's edge, and an appearance of dark pellets on the rim at contact. This is soon obscured by the sharp edge of the moon, the circular dent of which, in the sun's face, becomes clear, and the eclipse has fairly started. Gradually the moon creeps in along the path of the sun spots, the march of which becomes obliterated; and when it has obscured the sun by about one-fourth, the visible edge of tne moon is tinged with an orange-yellow tint. This extends to about two minutes of space, and was observable until the sun was more than three-quarters obscured. The changing shape of the sun, as it was gradually obscured by the moon, was particularly interesting; and as it acquired the crescent shape, light began to diminish, and the atmosphere got very cold. The horns of the crescent sun were strongly tinged with deep orange; and when the crescent became very fine, it appeared to me at one time that a portion of it was obscured before the time, which must have been caused by an irregularity in the moon's edge. The eventful moment approaches: there is just a thin strip of the sun now visible, which scintillates like the stars, and the light is like that from the electric arc, of a bluish tint, and all shadows are sharp; there is a weird appearance over everything. . . . Suddenly the shape of the moon begins to show beyond the visible edge on the sun, and soon the whole of the moon is visible—a blacker circle in a black background. Instantly the corona appears as an encircling light, opposite to where the sun yet shines, fully ten seconds before totality; when of a sudden, as if the moon, gradually toiling on, made one last effort, it took one great leap and obliterated the sun, as if for ever; it was, indeed, awe-inspiring, and it is impossible to describe the feeling of the moment. Immediately the sun disappeared, there was a beautiful transformation scene. It appeared as if the sun's place was occupied by a beautiful black jet ornament, set with scarlet points, and fringed with strings of pearls. . . . Twenty minutes after the total eclipse, the sun was obscured by clouds."

II.—The Temperature.

Mr. Meeson says, concerning the temperature:—"To get the variations in temperature during the continuation of the eclipse, I made use of two self-registering thermometers, which I inspected every quarter of an hour. One of these was fixed in its usual place, 6 feet above the ground, well in the shade, and protected from the wind; the other hung on the outside of a conservatory, 2 feet above the ground, and fully exposed to the sun. The following table gives the successive changes which took place:—

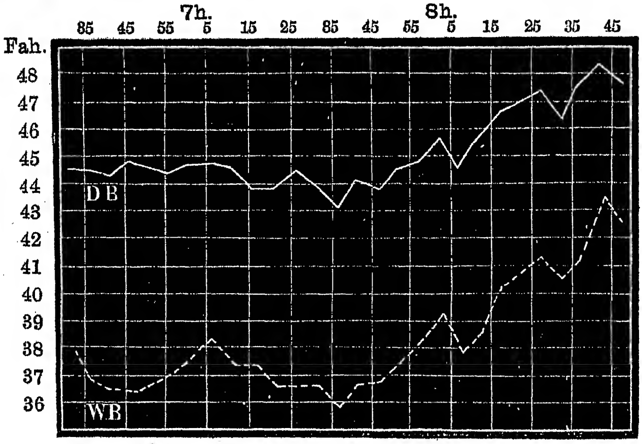
Time	½ to 7 a.m.	7	7.15′	7.30′	7.45′	8	8.15′	8.30′
Shade temperature	30° F.	32°	34°	35°	33°	31°	32°	37°
Sunshine temperature	30° F.	33°	39°	42°	36°	40°	50°	70°

"From this table it will be seen that my thermometers did not register such a great fall in the temperature as some observers report. In the shade there was a fall of four degrees, sufficient to carry the indicator below freezing point; and in the thermometer exposed to the sun, which more readily responded to the thermal changes, the fall was a clear six degrees. The coldest point of time seems to have been 8 o'clock, and not at the moment of totality—just as the coldest time during night is not at midnight, but two or three hours after, and the hottest part of the day not at noon, but about 2 p.m. If the early morning of 9th September had not been somewhat colder than usual—as a matter of fact the temperature then descended to 28° F.—perhaps the fall during the eclipse would have been more perceptible than it actually was; there was certainly a sudden fall at the moment of totality, for, though it was a minute of much excitement, everybody became sensible of the difference of temperature. The descent, however, recorded by the sunshine thermometer was, as we should have expected, greater and more sudden than that recorded by the instrument in the shade. I am quite prepared to believe that the actual fall during and immediately after totality was, as some observers say, even greater than that which I have recorded; but I find, in confirmation of my figures, that in Wellington the fall recorded was 5½°, and that the loss of temperature there was not recovered till nearly 9 a.m."

The Bishop of Nelson states that the thermometer stood at 38° immediately before sunrise, and that during the eclipse it went down to 31°, the whole ground being covered with hoar-frost immediately after totality. The reduction of temperature was very evident, as also the getting up of a strong south cold wind.

The temperatures observed by Mr. T. W. Kirk, in Wellington, on behalf of the Government Observatory, are embodied

in the accompanying diagram, showing the curves of dry and wet bulb standards, recorded at every five minutes' interval from 6.30 to 8.45 o'clock.



III.—The Prominences.

Mr. Meeson's paper contains the following remarks:—"As to the so-called red protuberances, I saw distinctly prominences, but they, one and all, seemed to me intensely white or pearly in colour—such as those described by Professor Airy in the eclipse of 1851—rather than red.

"Perhaps my sense of colour was temporarily impaired by the unwonted and unearthly hues which prevailed on everything at the time. I could persuade myself, perhaps, that one or two of the smaller prominences, situated on the eastward of D. in the chart, were of a faint rose-colour, but not red. Whatever their colour, and whatever their real nature—mountains, clouds, or flames—they were exceedingly beautiful and wonderful; but, as they can be, and are now, studied at any time when the sun can be seen, whether he be eclipsed or not—or rather, perhaps, as the sun can be by modern astronomical contrivances so artificially eclipsed that the prominences are rendered visible—it is very improbable that any observations of ours as to them can have any scientific value. The differences in our impressions as to the relative size and place of the prominences, arise probably from the fact that our observations were not made precisely at the same second of time. At the commencement of totality the largest prominences visible were those on the lower eastern or right limb; and towards the close they were those on the upper western, or left limb. During the passage of the moon across the sun's face, the prominences near where the sun was last visible diminished in size, while those directly opposite considerably increased. In astronomical books these prominences

are said to be heaps, jets, or flames. Those which we saw were heaps, I think, and they were less serrated and fantastic in shape than some of us perhaps expected. Decidedly the largest prominences, towards the close of the total obscuration, appeared over the moon's left upper limb, at an angle of about 30° from the perpendicular, directly below the point where I observed the longest and most vivid coronal ray. Its apparent height above the limb of the moon could not have been less than 70,000 miles, for it reached to nearly $\frac{1}{12}$th of the moon's apparent or angular diameter, which I take to have been about the same as that of the sun—

Say 2½′ — the sun's being 32′ 36·41″, or 850,000 miles in actual diameter,
the moon's 31′ 26″ ,, 2,153 ,, ,, ,,

How much this protuberance, or, indeed, any of the others, was foreshortened, of course it is impossible to say. The real height was perhaps in every case considerably above the apparent.

"Of two prominences I wish specially to speak. They do not seem to have been generally observed, but were clearly seen by other members of my household beside myself. One of them was also observed from the Hospital, by Dr. Boor. They were like tiny clouds, of a heapy character, and differed entirely from the other prominences, inasmuch as they were of a dun, or dark-smoke, nearly black colour. Their positions were, one at an angle of about 40° from the perpendicular towards the east, and the other at about 10° below the horizontal line on the lower western limb. Their position and relative size were recorded at the moment of observation. They were entirely different in appearance from the silvery or white, or rose-coloured prominences; and were no optical illusion, for I was so surprised to see them that I looked at them again and again with the binocular or coloured glass, and with the naked eye alternately. While I observed them, they seemed to undergo no change. What were they? Goldschmidt noticed similar little grey clouds in the eclipse of 1860, (Proctor's "Sun," p. 262,) but these were in part isolated, and floated, so to speak, outside the solar limb at some distance, and were also observed subsequently to develope into rose-coloured protuberances. Perhaps ours did the same, but the transformation was not observed by me. Someone says, 'Were they planets?' No; their size and irregularity of shape, apart from other reasons, would prevent us from entertaining that supposition. Were they faculæ projecting above the sun's disc, such as that seen by Mr. Dawes? (Proctor's "Sun," p. 180.) Were they such dark curves as Herr Grosch, of the Santiago Observatory, saw upon the moon's limb, in the total eclipse of 1867; sharp curves, resembling in appearance lines drawn with lead-pencil on white paper? (Proctor's "Sun," p. 346.) Were they mountains in the moon? If they were, lunar heights tower far higher than even those fabulous ones of Captain Lawson in New Guinea.

Professor Balfour Stewart, in one of the Manchester Science Lectures, says that the prominences sometimes assume the appearance of a cloud, instead of a fire or a fiery tree. If so, there need be no further difficulty. Our two little dusky patches have a place among recognized phenomena."

The Bishop of Nelson says :—" The intensification of brightness at certain points in the above mentioned ring of light (*see* General Description above), the chromosphere or ring, amounted to luminous protuberances, which to my eye, and I can only answer for that, had the appearance of molten mountains of liquid silver, increasing with every beating second in intensity of whiteness, combined with the idea also of light or luminousness. Light seemed to flow out of them in liquid streams. It was condensed, not dispersed light; to speak in popular language, it seemed as if it were light coming out in liquid streams: lava streams of silver, ever and anon coming out of the three craters of light. I saw no red flames, though, honestly, I tried to see them; I had one momentary glance of redness, but that was at an earlier stage. . . . It seemed to me as if I witnessed once more what I witnessed in the north of England, at Bolton, in Lancashire, in the pouring out of the cauldron of molten steel in the Bessemer process, in which I believe oxygen plays so important and striking a part."

Mr. A. S. Atkinson states as follows :—" The only 'red prominences' I saw were a row of six or seven small ones, extending from about the vertical point towards the east, looking to the naked eye of about the same size and shape, and at about the same distance apart. Larger ones were seen by others, and, I believe, appear in three places in the photographs. The tallest of these red prominences, measured very roughly on the photograph, seems to be about $\frac{1}{12}$th the diameter of the sun: if really so, it would represent a height of some 70,000 miles, while the long white cone I have mentioned (*see* Corona) was probably not less than 500,000 miles. Mr. J. R. Akersten obtained for me two small photographs during totality: one immediately after it began, with an exposure of something less than a second, the other a few seconds later with about double the exposure. A third plate was in the camera, and all but ready, when the sun reappeared; it was taken just after the reappearance, but two of the red prominences are still shown. It will also be noticed that in this photograph there is a rather well-marked ray, tangential to the reappearing sun, though not to the central point of the bright limb; or, say, not parallel to the line joining the two cusps; indeed, the latter line, if produced to the westward, would almost meet the ray as it is, without the latter being produced at all. There are also two short divergent rays of ordinary sunlight. There are also two short divergent rays from the eastern cusp, and a shorter and fainter one from the western

The tangential ray, measured from end to end through the glare, is apparently equal to two diameters; the longest of the shorter ones to little more than a quarter of a diameter. They are, I presume, rays of ordinary sunlight. If I might hazard a guess as to the cause of those from the cusps, I would ask whether they might not be owing to the irregularities of the moon's limb at those points, similar rays elsewhere along the limb being lost in the glare? It will also be seen that there is apparently a well marked halo round the emerging sun, which shows very strongly in the unenlarged original views. Whether this is merely the work of the camera, or is connected with the 'sun-cloud' now always surrounding the sun, or what else the cause may be, I am quite unable to say. I certainly did not see any such halo, but then I was closely watching the sun myself." (For a very similar halo in a photograph of the full moon, see "Nature," vol. xxi., p. 33.)

Mr. Goodall says: "While I was sketching, a flame seemed to burst out of the side of the moon in the opposite direction to where the sun was last observed, remain unaltered for a few seconds, then the corona gradually faded, and a flood of light was shed all round, and the grandest sight I ever witnessed came to an end. The scarlet setting, or the prominences, were very plainly visible through the telescope."

Dr. Hudson states: "Of prominences I saw two, marked *a*, and I thought I saw a flat low one in the position marked *v*. I did not see the prominence marked *c*, which, as it has been so universally observed, must have been a distinct and real one. The prominences appeared like burnished silver, with a slight coppery tinge."

IV.—The Corona.

With regard to this phenomenon, Mr. Meeson writes:—

"The general outline of the corona, towards the latter part of the period of totality, was, as it appeared to me, pretty much as represented in the accompanying chart, though there must have been other leading features which I had not time to observe. Generally its shape was irregular, and there was little or no four-cornered appearance. If there was any symmetry at all, it was as regards the place of the longest streamers (x and y), which were exactly on opposite sides, and at those parts of the sun's rim which were respectively the first and last to disappear behind the moon. Some of these streamers, particularly those from the upper western limb, and at an angle of about 30° from the perpendicular, could not have been less in length than $1\frac{1}{2}$ times the moon's or sun's apparent diameter, *i.e.*, not less than 1,275,000 miles. The greatest effulgence of light was in the neighbourhood of the longest

streamers, and particularly round about the highest part of the upper limb. The least was in the lower western and upper eastern limbs—in the former of which the breadth was not more than $\frac{1}{4}$th of the moon's diameter, and in the latter, certainly as small as $\frac{1}{12}$th, if not smaller. Although, for the most part, the streamers seemed to radiate as from a common centre—that is, the centre of the sun or moon—yet this was not universally the case; for some (particularly the ray marked *z*) seemed to proceed as from another centre, and interlaced with the more normal gleams. If these observations of mine—which have been compared and checked with similar notes and sketches made by other members of my family, whom I instructed beforehand, as well as I could, what to look for, and how to record—do not tally exactly with any *bonâ fide* photographic pictures of the eclipse which have been obtained in Nelson, two things must be remembered: One is, that the photograph is apt to give only the inner corona—the sierra, or leucosphere, as it is called—which is comparatively well-marked, and of stronger light; while the outer corona, or chromatosphere—perhaps on account of its more delicate light, or because there is inadequate exposure, or for some other reason—is very likely to be not at all represented. The other point to be remembered is, that the corona, or at all events the outer corona, varied in appearance at different periods of time during totality, for the rays visibly increased in length and altered in shape during observation. I read in Proctor's 'Sun' (page 314) that 'the sharpness of outline in photographs of the corona is due to peculiarities in the process of development, special care being needed to prevent over-development of the negative.' The corona in our eclipse was certainly not very sharply defined, for it was very difficult to say where the faint coronal tints ended and the abnormal hues of the sky began. If, as well as meteoric bodies and the sun's atmosphere, electric action plays a part in the formation of the golden glory which we are discussing, it might perhaps be expected that the appearance of that wonderful light would vary from moment to moment, even as in the case of the Aurora. Upon the whole, the picture which I present seems to agree pretty well with what others, with whom I have compared notes, observed. I noticed no rotatory motion of the beams, such as, I believe, has been sometimes previously observed, nor any flickering or quivering, except as before stated, just before and after totality. Proctor says of the eclipse of 1724, observed in France, that at the beginning of totality Maraldi perceived 'that the corona was wider on the side towards which the moon was advancing than on the opposite side, but that at the close of totality the case was reversed.' This exactly describes what I saw. The most vivid and brightest parts of the corona and the greatest prominences were decidedly

where the moon first touched the sun at the commencement of the eclipse, and at the point directly opposite thereto—that is, where the moon first emerged from before the sun's face. Proctor's generalisation, again, as to the relative development of the outer and inner corona, was certainly confirmed on this occasion. He says:—

"'1. Where any great gap or rift appears in the outer or radiated part of the corona, there a depression is seen in the inner and brighter portion.

"'2. Where the inner portion of the corona is depressed, there the coloured prominences are wanting, and the sierra is very shallow.'

"I think, if you will consider this carefully, you will agree with me, that what we saw confirms the generalisations here given. The colour of the corona, I should say, was that of very brilliant electric light, with, however, a faint but decided tinge of gold."

The Bishop of Nelson gives the following account of the corona, as seen by him:—

"No sooner had the luminous body of the moon established itself on the eyes, and the luminous ring or chromosphere with its protuberances—which seemed to my eye to be at points corresponding to 4 or 5 o'clock, 2 o'clock, and 11 o'clock on the face of the sun, treated as an imaginary clock face—there came the next grand spectacle, *almost* instantaneously, yet with a slight deliberation (worthy as of regal stateliness), with nothing of the scenic or startling transformation slide or scene about it: from the luni-solar disc as a centre, and from the chromosphere, shot forth the glory of the corona from all points—well-likened to a Brunswick star, and, if I may be pardoned for such a matter of fact association and illustration, reminding me of some of those feats of armour decoration which may be seen in the corridor of the White Tower of London, where stars of every order are formed of rays made up of the sheen of bayonets or ramrods, polished and burnished almost as white as snow. There was a tendency to a square shape impressed on the whole, with the exception of what was about the line of the moon's equator, the bright rays extending to quite a distance of $1\frac{3}{4}$ times the sun's diameter on that side, and not nearly so much on the opposite side. . . . On some occasions of total eclipses this corona has been said to be too bright to be gazed at by the unshaded eye, but it was scarcely so on this occasion; one could look at it without pain. It seemed to have a somewhat vibratory movement, coruscations of light playing on the rays of the luminous stars. I saw through the binocular glass certain faint leaf-like bands of light, but too faint and too momentary to make any

record of them. I also saw, before totality, bright rays crossing like St. Andrew's cross."

Dr. James Hudson remarks, with regard to the corona: "I can only speak certainly of the long projection, which I estimated at the time to extend three-fourths of the moon's diameter from the surface of the disc. This long projection appeared to me to be bifurcated at its extremity."

V.—The Bands or Rays of Light, immediately before and after Totality.

Mr. Meeson says, "This was a wonderful and unexpected phenomenon. While sun-gazing, perhaps a minute or two before totality, one of my party called out, 'Look! look at the waves of light behind us!' I turned, and was surprised to see a most beautiful effect, how produced, I cannot tell. It was as if streamers of light shot out from the quarter of the heavens where the eclipse was taking place, like the slender spokes of an enormous wheel of light, neither the nave nor the tire of which could be seen. All the time, too, the 'wheel' seemed to be rotating towards the west. The bands, as they stretched and quivered across the Waimea Plains, far as the eye could see, appeared to be about six or nine inches broad, and about the same space apart. Their direction was undoubtedly from north-east to south-west, and their colour was that of ordinary sunlight, only considerably subdued. During totality they disappeared, but on the sun's reappearance they were again visible, and riveted attention. Surely, thought I, the old fable is right, after all. There *is* a chariot of the sun! Phœbus, the son of Latona, guides it, and these bands are the light from his glorious wheels, as he drives majestically through the heavens. Yet, why visible now, and now only? And how is it that they do not seem to have attracted attention before now, when eclipses have occurred? You all saw what I am referring to. What were those quivering, mysterious, illimitable rays? Were they atmospheric, meteoric, spectroscopic, lunar, or coronal in origin?

"I could almost fancy that they were in the direction of the strongest coronal light, and might be produced by the *coronal rays*, which, before now, have been said to actually rotate. (Proctor's 'Sun,' p. 338.) The coincidence in point of time of the appearance of the two things is worth noting, as is also the coincidence of disappearance. But then it must be remembered that during totality, when the corona was most vivid, the bands of light were either absent altogether or exceedingly faint; at least that is my impression, though I cannot be positive about the fact, for at the time of total eclipse, my whole attention was

absorbed by the passing moon, and the coruscations of light about its limbs. Unfortunately man has not, like insects, compound eyes, enabling him to see at the same time both what is behind and what is before. If the ordinary beams of the corona did not produce the bands of light, *did the exceptional quivering rays, which appeared just before and after totality, above and below the sun, and referred to early in this paper, do so?* Or were the prominences or protuberances the cause of these mysterious bands? I mean, was their appearance in some way spectroscopic, as well as spectral?

"We must remember that, for spectroscopic effect, we had virtually an isolated and thin pencil of light from the sun, and possibly from the prominences only, immediately before and after totality, and, furthermore, that the sun-prominence spectrum consists of bright lines; and perhaps something invening between the sun and the earth—atmosphere, meteoric bodies, vapour—operated as a prism to produce refraction (just as rain does to produce the rainbow), or as a fine grating to produce diffraction. I think that the dark colour between the bands of light was the same as the general colour of things at the time; in other words, not that the bands of light were alternated with dark bands, but that they were simply light bands on a dark surface. Otherwise, the dark bands might suggest the innumerable dark lines of the spectrum, rendered visible in some mysterious way by the exceptional circumstances, with intervening bands only approximately and relatively light, but really of various colours, or in some way divested of colour. But then the dark lines of the spectrum, though innumerable, are very irregularly disposed; whereas the dark lines which we saw, if they were dark lines at all, were very evenly and regularly distributed, and alternated invariably with light bands, and the light and dark seemed to be exactly of the same breadth. My knowledge of the spectrum and its laws is very small, too small to permit of my doing more than suggest questions, which perhaps may very easily be disposed of.

"If these suppositions be unentertainable, was the phenomenon atmospheric in origin? Evaporation in the hot sunshine can often, as is well known, be seen most distinctly, the moisture, as it ascends from the ground, being rendered clearly visible by its quivering motion to the height of several feet. It can also be seen in long and strong streaks through a mass of distant clouds in certain conditions of weather. There was a rapid change of temperature about the time of totality, but it was towards a lower point, not towards a higher, and the lost degrees were not recovered till nearly half-past eight o'clock, as has been already explained. The quivering motion of evaporation occurs during exceptional heat, when the ground is, through recent rains, moist. The circumstances do not seem to be at all

parallel, nor, indeed, are the phenomena, for the matter of that; for our bands of light were broad, well-marked, and, I think, only slightly quivering, very different from the tiny, tremulous, hair-like threads of moisture seen during extensive evaporation. If these bands, then, were atmospheric in origin, how were they produced?

"I read (Proctor's, 'Sun,' p. 362) that General Meyer saw, from White Top Mountain, in Virginia, during the total eclipse of 1860, something similar, except that the bands were of various colours, and do not seem to have moved. He says: 'It was as if bands of broad ribbon of every conceivable hue had been stretched in parallel lines half round the universe.'

"If there had been such a thing as a lunar atmosphere, it might have been conceivable that the bands were in some way owing to the pencil of rays from the sun, just before and after totality, passing through that atmosphere on its way to the earth. But we are assured that there is no atmosphere worth speaking of in the moon; if one exist at all, it is of exceeding rarity. However, even a very thin, ethereal atmosphere, particularly if in the places where the rays intersected it, full of foreign matter of any kind, liquid, solid, or gaseous, would possibly occasion the spectral appearance, of the cause or causes of which we are in doubt.

"It has been seriously suggested by some of our members, that the bands perhaps represent successive jerks forward, made by the moon in its passage across the sun! Now, we must be well aware that there can scarcely be anything of the nature of a jerk or leap in the orbital motions of the heavenly bodies, as the forces producing those motions are steady, continuous, ever-pressing, eternal. Is it possible, however, that we can apply the atomic theory to motion, as well as matter? Of course, the movement of the heavenly bodies, inconceivably rapid as it is, is, at our distance (except in the case of meteors, shooting-stars, etc.) imperceptible, unless we look for a difference of position at consecutive points of time. But so is the movement of a man or a horse at a considerable distance, when going really at a very quick pace; as we approach nearer, however, we see that the movement which, further off, appeared so easy, even, and regular, really consists of a series of jerks forward. Just as, too, in the case of a railway train. If we had power of vision quick and keen enough to analyse the easy motion along the lines, we should see, I imagine, that it consisted of a series of jerks, each of which would represent the result of a contest between the power of steam and the resistance of friction. Now, apply this kind of reasoning to the motion of a celestial body, a star or planet, in its orbit. We know that, in accordance with the parallelogram of forces, that motion is in the direction of a diagonal between two lines, the one of which represents in length

and direction the centrifugal force, the other the centripetal. How, however, does the heavenly body comply with these forces, or, rather, acquire the direction of their resultant, except by a series of steps, so to speak, down or up a ladder—*i.e.*, by alternately giving way to one force and then to the other, each movement representing an atom of time as well as an atom of space? Granted that the atom of motion thus conceived of had real existence, the effect in light and shade, considering the magnifying effect of the great distance, *might be* possibly such bands of light as those we saw on the morning of the 9th September.

"This, however, you must understand, is only an attempt—and a bad one—to put another's crude suggestion into something like philosophical form. My own opinion is that the bands of light, in some way, were produced by the coronal rays, perhaps aided by something exceptional intervening in the space between them and the surface of the earth. But then, the non-appearance of the bands during totality seems a difficulty. I shall be very curious to hear what interpretation the astronomers in the old world put upon this phenomenon: and, by the way, I have not noticed that the observers in Wellington District observed it at all, though I can scarcely believe but that they did. If it were confined to the Nelson Provincial District, that surely would be a strong argument for thinking that the bands were simply produced by some local and temporary peculiarity in our atmosphere.

"Just one personal word in conclusion. I make no pretension whatever to astronomical knowledge or acumen. Carlyle is quoted as having said somewhere: 'Why did not somebody teach me the constellations, and make me at home in the starry heavens, which are always overhead, and which I don't half know to this day?' That was my feeling the other morning. With a hand trained for telescopic and other instrumental work, and an eye trained for the observation of heavenly objects, and a mind stored with astronomical principles and facts, the chance we have just had of observing and recording wonderful, rare, and mysterious phenomena was one which could have been used to grand advantage. Such a chance will probably never again fall to the lot of any of us."

The Bishop of Nelson states in his paper: "I am told by those at Collingwood that on the snow-covered hills above the Aorere there were broad *belts of colour of all shades*, and that the lighthouse and the Spit looked from Collingwood as if they were close at hand, within walking distance."

Mr. Atkinson writes: "As the sun was just disappearing, the most striking phenomenon I witnessed, looking straight at it, was a strongly-marked 'pulsation' in its light; those who were looking away from it saw waves of shadow passing rather rapidly along the ground, just after as well as just before totality. This,

also, I supposed was from the unsteadiness of the air; but to me it seemed certainly not the least striking part of the great spectacle to see the sun flickering, as it were, before it went down."

Dr. J. Hudson says on this subject: "About five minutes before totality I was standing with my back to the sun, looking on the ground in front of me, when I saw fine films floating over the surface of the ground. I rubbed my eyes, thinking there must be water in them, and looked again; there were the films plainer than before. Soon they began to take more definite shape, and appeared as long bands of light and shade, moving rapidly across the field of vision from E.S.E. to W.N.W. I thought for a moment, were they the shadows of clouds of mist? I looked up, but the whole atmosphere was perfectly clear, besides there was no wind; I held up my hand to feel, and it was then what I should call a dead calm. However, there were the long lines of light and shadow travelling rapidly in a westerly direction, and more and more distinct did they appear until the moment of totality, when they completely disappeared, to reappear again when totality was over. I cannot say what direction they travelled in after totality."

Mr. A. Coleman, in his "Observations on the Solar Eclipse," says:—

"The phenomenon which most struck me, and to which I believe I paid the most attention, was the peculiar vibratory shadows which passed across the earth's surface during the eclipse. Scientific observers have no doubt recorded and fully accounted for this striking phenomenon, but never having read of such, nor having seen any explanation for them, I venture to offer one, which, however, may neither be original nor correct. A curious property of light, discovered by Grimaldi in 1665, later on independently by Newton, but more thoroughly investigated by Fremel, was that termed the inflection or diffraction of light. When a divergent ray of light admitted into an apartment was just intercepted by an opaque spherical body of a suitable size and at a suitable distance, surrounding the shadow cast upon a screen were seen concentric rays of coloured light, 'the fringes' of Grimaldi, whilst in the shadow itself were to be seen alternate light and dark bands of light.

"In investigating this latter phenomenon, Dr. Young saw that they were capable of a satisfactory explanation upon his admirable and comprehensive undulatory theory. To use his own words, 'the fringes within the shadow were produced by the interference of the rays bent into the shadow by one side of the body (intercepting) by the rays bent into the shadow by the other side.'

"In the present instance the moon's disc formed the obstructing body, causing the light and dark bands in its

shadow on the earth's surface, and their flickering movements were due to the moon's movement altering continuously the distance of the undulations from either side of the moon, and with them the positions of the shadows."

Observing at Tahoraite, Mr. A. McKay, of the Geological Department, remarked the flickering of different shades of light at the surface of the ground, and on looking up obliquely towards the sun, saw most distinctly undulating vibrations in the air like those produced by ascending currents. From his position he had a favourable opportunity of observing during totality the return of the light in the rear of the shadow on the Ruahine Ranges, 6,000 feet in altitude, and about 6 miles to the westward, and he distinctly saw the light advancing as banded streamers.

NOTE.—The Ven. Archdeacon Stock has called the Editor's attention to the following extract from the London *Athenæum*, August 2nd, 1851, p. 821, which evidently points to a similar phenomenon having been observed on the occasion of a previous total eclipse:—

"*Great Solar Eclipse.*—In observing the solar eclipse here yesterday, during the intervals that the showery and cloudy state of the weather permitted, I noted the following fact, which I am not aware has been before observed, and which may be interesting as in a great degree explanatory of some of the most remarkable phenomena attending total eclipses. The rays passing close to and over the moon's body were much agitated. This I at first was inclined to ascribe to the vapoury state of the atmosphere, but soon noticed that could not have been the cause, as the light from the sun's external limits was calm, and gave a most distinct marginal line, while that portion of the sun's face which was bounded by the convex and dark outline of the satellite and that outline seemed to be *dancing together*. In case of any mistake, I caused two friends successively to examine the appearance, and they both reported it to be distinctly such as described. The instrument used was a Newtonian reflector, of 6 inches diameter, with a magnifying power on of about 180.—I am, &c.—P. McFARLANE.—Comrie, Perthshire, July 29, 1851."

EXPLANATION OF PLATES XIV.—XVI.

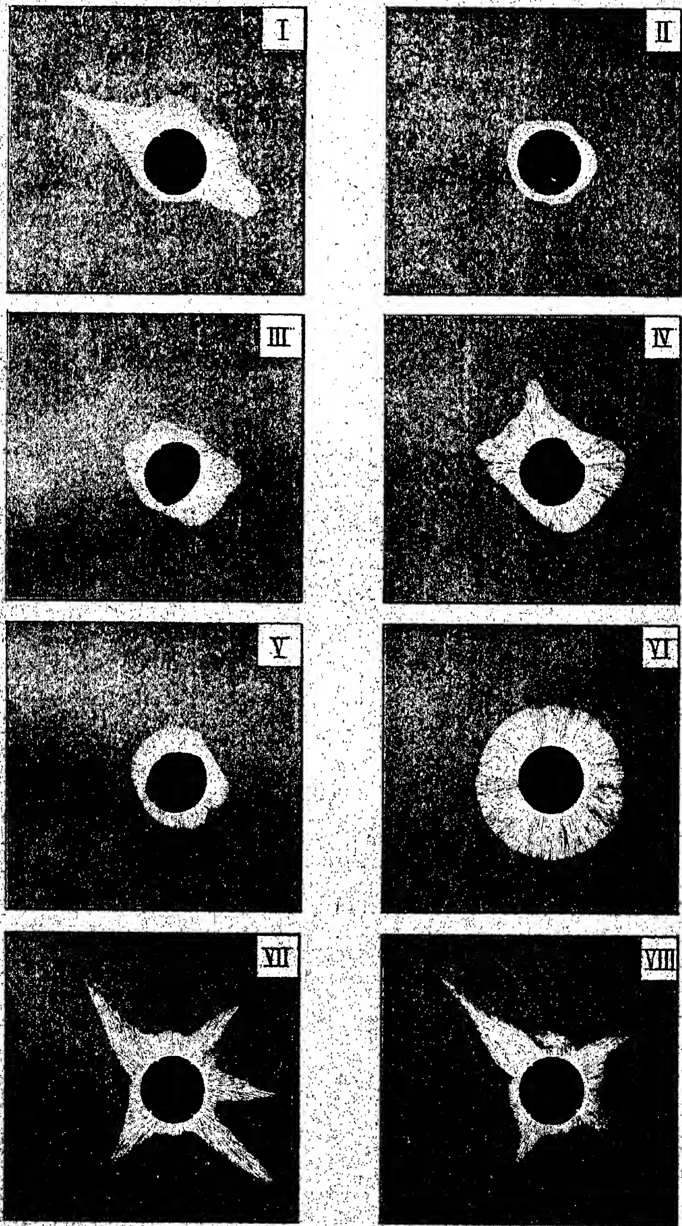
Fig. 1.	Combined from several.	Eye sketch, Wellington (Petone).
2.	Mr. Gell	Photograph print, Wellington.
3.	Mr. Holmes	,, ,, ,,
4.	,,	,, ,, ,,
5.	,,	,, ,, ,,
6.	Mr. Parsons	Telescopic sketch (high power), Wellington.
7.	Mr. Higginson	,, ,, (low power), ,,
8.	Mr. W. B. Hudson	,, ,, ,, Karori.
9.	Mr. T. W. Kirk	Eye sketch, Wellington.
10.	,,	,, ,,
11.	,,	,, ,,
12.	Mr. Goodbehere	Photograph print, Taonui.
13.	Mr. Goodall	Eye sketch, Tahoraite.
14.	Mr. Harding	,, Danevirke.
15.	Mr. McKay	,, ,,
16.	,,	,, ,,
17.	Mr. Seymour	Telescopic sketch, Picton.
18.	Mr. Tyree	Photograph print, Nelson.
19.	Bishop of Nelson	Eye sketch, Nelson.
20.	Mr. Meeson	,, ,,
21.	Mr. Innes Jones	,, ,,

Art. LX.—*The Maintenance of the Sun's Heat.* By Professor F. D. Brown. *(Abstract of a Lecture.)*

[*Read before the Auckland Institute, 29th July,* 1885.]

The maintenance of the sun's heat: of what possible interest is this? perhaps you will say. Nevertheless, it is recorded that, centuries ago, a man was tending a flock of sheep, when he saw "a flame in the midst of a bush, and the bush burned with fire and was not consumed." And this man, although he lived at a time and in a country where no spirit of inquiry existed, yet thought that this was a matter of the greatest interest, for he said, "I will now turn aside, and see this great sight, why the bush is not burnt." Why, then, should we not turn aside for a few minutes, and ask ourselves, How is it that that great blazing mass, which daily lights and warms us, burns, and is not consumed? But it may be said that there is here a pure assumption introduced, to lend a fictitious interest to the subject; that there is nothing more remarkable in the existence of a vast mass of matter at a white heat than at any other temperature, and that the extraordinary statement that the sun is not consumed has no basis in fact, or, at any rate, cannot be proved.

The first point, therefore, for us to consider is, whether the sun does behave in a manner altogether different from ordinary fire, or a white-hot ball; whether he keeps on shining longer and more fiercely than a fire of his size could do. The solution of this question is by no means difficult, though it involves the use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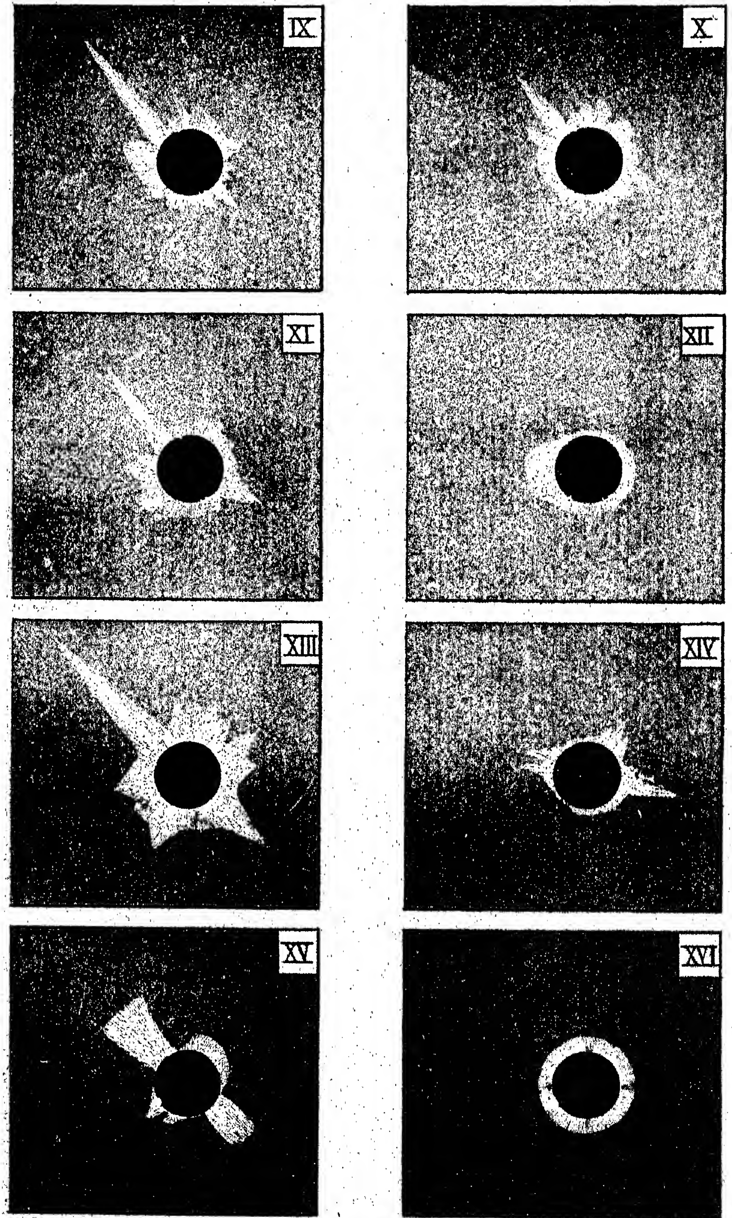
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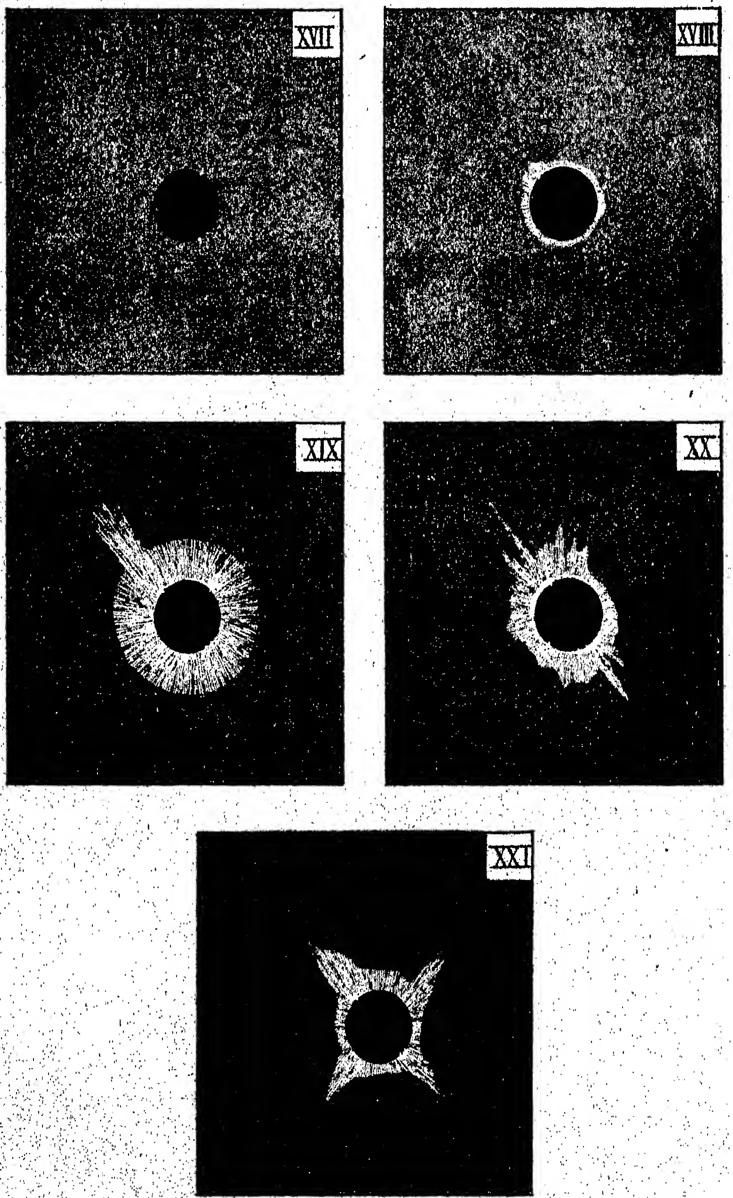
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XXI

of some very large figures. It is evident that we must first find out how much heat the sun loses in an hour, or a week, or a year, and then compare this amount with the quantity which could be evolved by a hot or burning body as big as the sun.

We are all of us fully aware that the sun radiates heat, but there are probably only a few here who have ever thought about the quantity of heat thus radiated, or who have any definite idea of the enormous thermal loss which the sun daily undergoes.

To learn how much heat the sun loses in a given time, we must measure the amount of radiation on a given area of the earth's surface. Since the radiation is going on simultaneously in all other directions, it is clear that every square mile on the surface of a sphere of which the radius is 95,000,000 miles will be equally warmed; we must therefore, to find the total radiation, multiply the number we have obtained by the number of square miles on the surface of this sphere, that is, by 108,000 million million. Many measurements of the solar radiation have been made with more or less perfect apparatus. The first, which were carried out at the Cape of Good Hope by Herschel, led to the conclusion that the solar radiation on a square mile would raise 47,500,000 lbs. of water from freezing to boiling in an hour. In obtaining this result, however, no account was taken of the large amount of heat absorbed by the atmosphere, an amount which varies with the humidity of the air, and with the obliquity of the sun's rays. Allowing for this atmospheric absorption, and basing our calculation on the experiments of Violle, which are probably the most exact, we find that the solar radiation per square mile per hour, just outside the earth's atmosphere, would raise 85,500,000 lbs. of water from freezing to boiling. Multiplying this number by 108,000 million million, we obtain an expression for the total hourly solar radiation which is, according to Tyndall, sufficient to boil 700,000 millions of cubic miles of ice-cold water per hour. If, now, we consider how this loss would affect the temperature of a hot body of the mass of the sun which received no heat from any source, we find that it would result in a fall of the sun's temperature of at least 2° C. annually, or 10,000° in 5,000 years; yet all the evidence accumulated by geologists goes to show that in bygone ages the sun's rays were no hotter than they now are. If, on the other hand, we suppose that the sun is a vast burning mass, we find that if it were made of solid coal, and were burning at a rate sufficient to yield this enormous supply of heat, it would be all consumed in 6,000 years. As no apparent diminution of the solar radiation has taken place for thousands of years, I was justified in comparing the sun to the bush in the desert, which burnt, yet was not consumed.

Two well-known hypotheses have been set up to account for the maintenance of the sun's heat; the one ascribes it to a great

shower of meteorites, the other to the gradual contraction of the sun's mass. To appreciate the meteoric theory we must remember that whenever the motion of a body is destroyed, and no other motion set up in its place, heat is evolved ; thus, when I bring this hammer on this piece of lead its motion is stopped, and the lead thereby becomes hot. (*Exp.* with thermopile.)

The heat thus generated is proportional to the mass of the moving body and the square of its velocity, and is so great that if the earth fell into the sun, the heat generated would be equal to that obtained from the combustion of 5,600 worlds of solid carbon. There is, therefore, nothing improbable about this meteoric theory, and its supporters go so far as to point to the zodiacal light as material evidence of it, saying that this light is emitted by a vast meteoric cloud. The adequacy of this theory, as regards the possible supply of heat, is well brought out in the following table, which is due to Sir W. Thomson :—

	Years.	Days.
Mercury	6	219
Venus	83	326
Earth	95	19
Mars	12	259
Jupiter	32,254	0
Saturn	9,652	0
Uranus	1,610	0
Neptune	1,890	0
Total	45,604	103

It is, however, very doubtful whether there is any such supply of meteoric matter as is required by this hypothesis. The earth encounters but little, and there is no valid reason to suppose that the zodiacal light results from meteoric matter.

The second hypothesis, which is due to Helmholtz, refers the sun's heat to the simple contraction of its mass ; and, in order to show the sufficiency of this theory, it has been calculated that the contraction of the sun from a nebula the size of the orbit of Neptune to its present bulk would yield a sufficient heat to maintain the present rate of radiation for 120,000,000 years, while a contraction of the sun's diameter of about 300 feet per annum would make up the yearly loss. The chief obstacle to the acceptance of this explanation of the origin of the sun's heat is the fact that the heat due to contraction would be set free throughout the sun's mass, and that it is almost impossible to imagine it reaching the surface in time to prevent the sun's surface from becoming cold.

Either of the two hypotheses which I have briefly put before you account fairly well for the fact that, in the period of a few thousand years during which some sort of written record has been kept, no diminution of the sun's heat has been observed ;

but both of them place a limit to the solar life. In the case of the meteoric theory, it cannot be supposed that the supply of meteors is inexhaustible; we must look forward to the time when every stone wandering in the planetary spaces shall have fallen into the sun, and when, therefore, the supply of heat shall cease, a time to be followed at no great distance by the dying away of the solar light. Since a mass of matter cannot go on contracting for ever, it is evident that the shrinkage theory, like the meteoric, cannot invest the sun with the attribute of permanence. In this respect they both fail to commend themselves to the mind, as has been said by Sir W. Siemens: "If either of these hypotheses could be proved, we should only have the satisfaction of knowing that the solar waste of energy by dissipation into space was not dependent entirely upon loss of its sensible heat, but that its existence as a luminary would be prolonged by calling into requisition a limited, though may be large, store of energy in the form of separated matter. The true solution of the problem will be furnished by a theory, according to which the radiant energy which is now supposed to be dissipated into space and irrecoverably lost to our solar system, could be arrested and brought back in another form to the sun itself, there to continue the work of solar radiation."

In accordance with this idea, Sir W. Siemens propounded a theory regarding the conservation of the sun's heat, which I will endeavour to explain to you. In order to understand this theory we must suppose that the planetary system is immersed in a rarified atmosphere, consisting mainly of hydrogen, marsh gas, carbonic oxide, water vapour, etc.; that this is no unreasonable assumption is made clear to us by the fact that it has been proved by Maxwell, Clausius, and Thomson that it is impossible to assign a limit to a gaseous atmosphere in space. The nature of this interplanetary atmosphere is, moreover, made known to us by the meteorolites which frequently find their way to the earth; these meteorolites contain gases hidden in their pores, which, being other than oxygen or nitrogen, must, one would think, have been derived from the interplanetary spaces. These gases are those just enumerated. Further proof, if any be needed, of the existence of gaseous matter in interstellar space, is furnished by spectrum analysis, which tells us that the nucleus of a comet contains carbon, hydrogen, nitrogen, and probably oxygen.

Having arrived at a conception of an interplanetary atmosphere, we have next to think of the action of the sun upon it. Let us first investigate the action of any revolving body upon the gaseous medium in which it is placed. (*Exp.*, wheel and candles.)

We thus see that the sun must act like a great fan, projecting the gases from its equator, and drawing them in at its poles.

Let us think of the stream of hydrogen, oxygen, marsh gas, etc., arriving near the sun at its poles ; the rise of temperature will evidently bring about combustion, with its accompanying great development of heat. The result of the combustion, the aqueous vapour and the carbon dioxide, will flow to the solar equator, and be projected into space. Thus it would appear that the constitution of the interplanetary atmosphere would be gradually altered ; but Sir W. Siemens here steps in with the suggestion that the solar radiation would bring back the combined materials to their original condition of separation, thus enabling them again to flow towards the sun, and by their second combustion supply the central power with further energy. It remains to show how this could take place.

There is no fact better known to students of chemistry than the decomposition of substances by heat. Nearly all organic substances and many metallic salts are resolved into simple compounds by exposure to heat, while such stable bodies as the metallic oxides, and even water itself, are broken up at a high temperature. The explanation of this very general phenomenon is as follows :—The substances are made up of particles, which are all exactly alike, and all complex, being themselves formed by an aggregation of atoms. These atoms, within the particle or molecule, are subject to definite periodical motions or vibrations, which increase in amplitude with the temperature. It is therefore evident that, as the motions of the atoms within the molecule gradually increase in violence, the time must arrive when the cohesive forces which hold them together must be overcome, and the atoms flying off in different directions will either remain at large, or will come into contact with others derived from other particles, forming, in the majority of cases, simpler aggregations. The destruction of the particles is, in fact, not unlike that of a fly-wheel which is rotated more and more rapidly, until at length the centrifugal force overcomes the cohesion of the iron, and the wheel flies to pieces.

Now, it has been shown by Tyndall and others, that vapour of water and other gaseous compounds possess a remarkable power of absorbing the vibrations of radiant heat, the violence of the atomic vibrations becoming thereby greatly augmented. Nevertheless, under ordinary circumstances, no decomposition is apparent. At low pressures, however, the decomposition is greatly increased, and it is reasonable to suppose that, at the extremely low pressure which reigns in the interplanetary spaces, the destruction of the molecules would be considerable.

Here, then, we have an hypothesis which explains how the solar radiant energy is not lost, but gathered up by the particles of matter distributed in space, to be poured again into the sun by the great gaseous current which circulates among the planets.

Let me, in conclusion, sum up the main conditions of this hypothesis :—

(1.) That aqueous vapour and carbon compounds are present in stellar or interplanetary space.

(2.) That these gaseous compounds are capable of being dissociated by radiant solar energy while in a state of extreme attenuation.

(3.) That these dissociated vapours are returned to the sun, and exchanged for recombined vapours by the centrifugal action of the sun.

As Sir W. Siemens has remarked : "If these conditions could be substantiated, we should gain the satisfaction that our solar system would no longer impress us with the idea of prodigious waste through dissipation of energy into space, but rather that of well-ordered, self-sustaining action, capable of perpetuating solar radiation to the remotest future."

VI.—CHEMISTRY.

Art. LXI.—*On a New Mineral* (Awaruite) *from Barn Bay*.

By W. Skey.

[*Read before the Wellington Philosophical Society*, 21*st October*, 1885.]

On the 28th of September two samples, marked Nos. 1 and 2, were transmitted to the laboratory through the Secretary for Mines, as having been obtained by some alluvial miners working near Jackson's Bay, and given by them to the Warden. No. 1 of these parcels, supposed by the contributors to be impure platina, was found not to contain any platina, and to consist entirely of a pure alloy of nickel, iron, and cobalt, in the form of small nuggetty and water-worn grains or scales, perfectly malleable, of a hardness of about 5· and sp. gr. 8·1. Some of these grains have a little lustre, but most of them are dull, owing to a coating of reddish or greenish red oxides. These grains do not reduce copper from its cupreous sulphate, acidulated with muriatic acid. The following is its composition:—

Nickel	67·63
Cobalt	·70
Iron	31·02
Sulphur	·22
*Silica	·43
Total	100·00

Its formula is 2 N + Fe. It is remarkable for the high pro portion of nickel therein. The richest natural alloy of nicke of which I can find any notice is *Oktibehite*, from the United States of America; it is Ni + Fe, according to which formula there is 51·22 per cent. of nickel present. This alloy (Oktibehite) is of terrestrial origin. Meteoric iron does not often go more than 10 per cent., with a maximum of 20 per cent.; it generally contains carbon.

The New Zealand alloy is undoubtedly of terrestrial origin, and should be found in some basic rock in the vicinity of Barn Bay. The even size of the grains, and their number, together with their richness in nickel and apparent uniformity of composition, support the "terrestrial" theory. The inability of

* This has all been set free from combination with one or other of these metals.

this alloy to reduce copper from its acid solution of cupric sulphate, is very singular, as both iron and nickel rapidly effect a reduction, separately. This fact shows that the two metals are (in the alloy) combined with each other, and it shows, besides, the unreliability of the copper test for demonstrating the absence of iron alloys from our rock masses, this test being as yet the only one in use for this purpose. Possibly there is a connection, and a close one, between this alloy and the nickeliferous pyrrhotine of the West Coast, which I identified in 1878.

Nickel some time ago was quoted at 12s. the pound; it is supplanting silver (as nickel-silver) for many purposes, such as for harness.

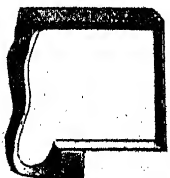
The mixed sand, or wash No. 2, accompanying the alloy, also contained a similar substance, but in smaller grains, while, besides gold—which has escaped the rough appliances of the miners—it contains two kinds of platina, one markedly ferriferous, the other nearly pure. It besides contains tin ore (cassiterite) in quantity, a fact which it appears the contributors did not suspect. This is a new locality for tin ore, and a great deal further south than are any of our other deposits of this ore. The following is the proportional composition of this sand:—

Nickeliferous alloy	24·77
Tin ore	32·14
Magnetite	19·68
Various	23·41
	100·00

Art LXII.—*On Platinum Crystals in the Ironsands of Orepuki Goldfield.* By W. S. Hamilton.

[*Read before the Southland Institute, 26th January*, 1886.]

I have obtained several crystals of platinum from this source, which, though minute, are tolerably perfect, one of the largest of which is figured. It is a square flat tablet, very perfect on three sides, but irregular on the fourth, with one corner deformed. The entablature is very distinct on the face presented, but not on the obverse. There are markings on the surface, as if thin squares and parallelograms of metal had been beaten into it, giving it somewhat the appearance of a brick floor, and suggesting a compound crystal built up of smaller



ones. These crystals occur in the grains of sand. Their occurrence is, however, somewhat rare. The common form in which the platinum occurs is round or oval thin plates, or leaves. But the fact that crystals do occur is important, as proving that the iron-sand is their true matrix. Roughly crystalline platinum also occurs, sometimes with gold crystallised on it, as well as iridium, iron, and native copper. The iron-sand in question is not the ordinary titanic iron-sand of our beaches. It is non-magnetic, or but slightly so, heavier, and lumpier. Lumps of comparatively large size often occur in it, which are iron pyrites derived from wood, and still retaining the original mineral elements of timber, and often some carbon. This is proved from the fact that twigs and small branches are often found along with the sand, completely changed into pyrites, though still retaining the grain, the bark, and all the characteristics of timber. Specimens of these undeniable branches occur where the wood structure is perfect in some parts, while in other parts it is broken up into masses resembling duck-shot, partially fused together. This, I apprehend, gives us the key to the origin of the sand, which seems to be nothing else but the pyritized *dēbris* of ancient vegetation subjected to special conditions, which we may yet come to understand.

Just as wood is often silicified into stone in large quantities, or carbonized into coal, so it would apppear that it may be *metallized* into the iron-sand of our goldfields, auriferous, cupiferous, or platiniferous, from either some obscure conditions of process or inherent quality of the original substance. These pyritized twigs are curiously shrunken to a far smaller size than their original, some of them being reduced to the thinness of needles, whilst still showing wood structure. The iron-sand of many of our goldfields seems to be derived from the breaking down of this pyritized wood by mechanical and chemical means, such as water-wearing and rusting. The sulphur of the pryites is gradually replaced by oxygen to form the *magnetic* oxide, probably determined by the conditions of deposit, temperature, etc. In this way, the magnetic iron-sand of our beaches would be the ultimate product of timber, after being first reduced to wood pyrites, and then broken down by oxidation and the action of mechanical agents, and finally changed into the magnetic oxide, the other metals crystallizing out.

This change can actually be effected experimentally by the artificial oxidation of the non-magnetic lumps of wood pyrites, with the production of magnetite in all respects similar to the titaniferous iron-sand of our shores. Either sulphuric or nitric acid will effect this by long continued action. The grains of sand do not dissolve, but become semiplastic, lose their sulphur, and recrystallize into highly magnetic angular grains of the ordinary magnetic iron-sand.

The renewal of the gold in our beach workings seems to be an example of this slow change of the iron-sand derived from wood pyrites. Miners observe the same renewal of gold in the washings of the Orepuki Goldfield. They save the heavy iron-sand for that purpose, and after a few months, re-amalgamate with good results. This can be repeated ever so often, gold and platinum being continually set free by the chemical changes induced. The fact, as proved in this paper, that both occur crystallized in the sand, affords grounds for supposing that they are really developed or crystallized out of more complex combinations.

NEW ZEALAND INSTITUTE.

NEW ZEALAND INSTITUTE.

SEVENTEENTH ANNUAL REPORT.

MEETINGS of the Board were held on the following dates: 30th September, 1884; 3rd February, and 13th May, 1885.

The members of the Board who retired in conformity with clause 6 of the Act were: The Hon. Mr. Waterhouse, Mr. Travers, and Mr Mason, and these gentlemen were reappointed as Governors of the Institute by His Excellency.

The members elected to the Board for the current year by the incorporated societies are: Dr. Buller, Mr. James McKerrow, and Mr. W. M. Maskell.

The following additions were made to the honorary members of the Institute: Professor Asa Gray, Richard Bowdler Sharp, M.A., F.L.S., and R. A. Wallace, F.L.S.

The members now on the roll of the Institute are:—

Honorary members	30
Ordinary members—	
Auckland Institute	304
Hawke's Bay Philosophical Institute ...	121
Wellington Philosophical Society ...	250
Westland Institute	110
Philosophical Institute, Canterbury ...	149
Otago Institute	161
Southland Institute	70
Nelson Philosophical Society	100
Total	1,295

The volumes of Transactions now in stock are: Vol. I. (second edition), 395; Vol. V., 44; Vol. VI., 43; Vol. VII., 140; Vol. IX., 145; Vol. X., 176; Vol. XI., 55; Vol. XII., 62; Vol. XIII., 63; Vol. XIV., 85; Vol. XV., 198; Vol. XVI., 230; Vol. XVII., not yet fully distributed.

The printing of Vol. XVII. was commenced in February, and completed and issued early in May. It contains fifty-five articles, and also addresses and abstracts of articles which are included in the Proceedings and Appendix. There are 536

pages and twenty plates. The following is a comparison of the contents of the volume with that for the previous year :—

	1885. Pages.		1884. Pages.
Miscellaneous	80	...	72
Zoology	212	...	324
Botany	94	...	118
Chemistry	—	...	4
Geology	50	...	18
Proceedings	35	...	46
Appendix...	65	...	62
	536		639

The Honorary Treasurer's statement of accounts is appended. There is still a small amount due on account of the last volume, but, on the other hand, there is a balance to the credit of the Institute in the hands of the London Agent.

Approved by the Board.
Wm. F. Drummond Jervois,
Chairman.

James Hector,
Manager.

18th August, 1885.

New Zealand Institute Account, 1884–85.

Receipts.	£.	s.	d.	Expenditure.	£.	s.	d.
Parliamentary vote for 1884-85	500	0	0	Balance due for printing Vol. XVI.	74	11	5
Contribution from Wellington Philosophical Society, one-sixth annual revenue	24	3	0	Printing Vol. XVII. (on account)	526	18	7
Contribution from societies in aid of printing Vol. XVII. under clause *d* of Regulations of Institute	79	5	0	Miscellaneous items, including binding, &c...	8	4	0
Sale of volumes.. ..	6	6	0				
	£609	14	0		£609	14	0

Arthur Stock,
Honorary Treasurer.

18th August, 1885.

PROCEEDINGS.

WELLINGTON PHILOSOPHICAL SOCIETY.

First Meeting. *24th June*, 1885.

Dr. Hector in the chair.

New Members.—Mr. A. Purdie, B.A., and Mr. W. M. Maskell, F.M.S.

Papers.—1. "On a remarkable variety of the New Zealand Pigeon, *Carpophaga novæ-zealandiæ*," by T. W. Kirk. (*Transactions*, p. 129.)

2. "Abnormal colouring in *Platycercus auriceps*," by T. W. Kirk. (*Transactions*, p. 129.)

3. "New Paper Nautilus, *Argonauta bulleri*," by T. W. Kirk. (*Transactions*, p. 138.)

Specimens Exhibited:—(1) *Ancient Maori kite*, made of raupo, and exhibited by Sir George Grey. (2) Five specimens of *Helix hochstetteri*, presented by Hon. Captain Baillie, whose property near Picton is almost the only place where that shell is now obtained. (3) Specimen of auriferous *Pinolite*, a magnesian rock combined with dolomite, presented by G. S. H. Cox, F.G.S. New South Wales. (4) *A bonita*, a very rare fish in New Zealand, which had been purchased at a fishmonger's shop in Wellington. Dr. Hector took occasion to refer to the reported finding of a *turtle* in Foveaux Straits, and reminded the meeting that a few years ago a turtle came ashore at Island Bay, together with a number of strange fish belonging to the coast of New South Wales, and a mass of kelp. (5) An interesting book, entitled "Cooke's Voyages in the years 1708-11," presented by Mr. Justice Gillies, of Auckland. The book contains numerous plates of birds, beasts, and fishes found in these seas; and New Zealand is marked on the chart as a nebulous patch. (6) Facsimiles of ancient classics, an *Epinal Glossary of Latin* and Old English. (7) Geological specimens from the collection of Mr. McKay, made during his recent survey of the Kaikoura mountains. Dr. Hector spoke for some time on the geology of that district, and testified to the valuable nature of the work being done by Mr. McKay. (8) Portrait in oil of Manihera, recently presented to the Government by the relatives of the deceased, and which had been forwarded to the Museum.

Mr. T. W. Lewis, Under-Secretary for Native Affairs, was present, and gave a short account of Manihera's career, stating that he had been a friend to the settlers from the very early days, and a loyal servant to the Crown.

Manihera's brother (Hoane Rangitakaiwaho), his son (Robert Hector Manihera), and his nephew (John Alfred Jury) were present at the meeting, and the latter, who spoke English with an excellent accent, related some episodes from Manihera's life. He stated that Manihera and Wi Kingi opened the land in the Wairarapa to the settlers; and when Te Hapuku tried to oppose Sir Donald McLean in Hawke's Bay, by refusing to permit the land to be sold, Manihera went up and got Te Hapuku to agree to it. When the Hauhau fanaticism and the King movement spread to the Wairarapa, Manihera used his influence to pacify the Natives with success.

The Hon. Mr. W. B. D. Mantell, M.L.C., said he had held Manihera in very high esteem, but suggested that the portrait would find a more fitting place in the corridor of the House of Assembly.

Dr. Hector differed from this opinion, remarking that, in its present place, the general public would have the benefit of being able to see it.

Before concluding the meeting, Dr. Hector stated that Mr. John Buchanan, F.L.S., who had been connected with the Geological Survey for over 20 years as a botanist, draughtsman, and explorer, was about to leave the Government service, to retire on a well-earned pension; and he expressed, in feeling terms, how much the Society would lose in Mr. Buchanan. He referred at length to the valuable services rendered to the Society during the past 18 years by that gentleman, by his execution of the illustrations and diagrams, as well as by his numerous papers.

Dr. Hector then referred to his personal acquaintance with Mr. Buchanan, and related how, when he left for New Zealand in 1861, Sir Joseph Hooker gave him the name of John Buchanan, as that of a remarkable botanist, stating that if his services were secured in connection with the Geological Survey, a great benefit would be rendered to science.

A few months after landing, the speaker made his acquaintance, and they had been together ever since. They had undergone many hardships together, having on one occasion spent five or six months in the dingy cabin of a little schooner, when exploring the West Coast Sounds, with rain falling steadily for six weeks at a time. He spoke of Mr. Buchanan's ability at designing diagrams and maps, and exploring, or any work requiring the finest artistic touch or taste, in very high terms. At the close of his remarks, the Chairman, on behalf of the Society, handed to Mr. Buchanan an illuminated diploma of life membership, signed by the President, Vice-Presidents, and Council of the Philosophical Society, as a small token of the esteem in which his services were held. The diploma was handsomely illuminated by Messrs. Bock and Cousins. The diploma was accompanied by a present of several valuable books, chosen by the Council. The meeting signified its approval of the gift by hearty acclamation. Mr. Buchanan was quite taken by surprise, and was, in consequence, too much moved to reply at any length.

29*th July*, 1885.

Dr. Grabham, Vice-President, in the chair.

New Members.—Mr. W. E. Vaux, and Mr. John Davies.

Paper.—"On the Improvement in Vegetable Food in Western Europe since Neolithic Times," by W. T. L. Travers, F.L.S. (*Transactions* p. 30.)

Mr. A. de B. Brandon read a paper entitled "Suggestions," with a view to secure uniformity in expression in papers published in the "Transactions," especially in relation to minute measurements; and the meeting generally agreed that such a course would be of advantage.

12*th August*, 1885.

Mr. W. T. L. Travers, F.L.S., in the chair.

Paper.—"On the Maori in Asia," by Mr. E. Tregear. (*Transactions*, p. 3.)

23rd September, 1885.

Dr. Newman, President, in the chair.

New Member.—Rev. E. Durant Cecil.

Papers.—1. "On a New Seismograph, or Earthquake Recorder," by Mr. F. Bull. (*Transactions*, p. 69.)

In concluding his paper, the author said he hoped the instrument would recommend itself to the Meteorological Department for issue to observers.

Dr. Hector agreed that the instrument was a very useful one, but he hardly thought it combined all that was required for very accurate resnlts, and that Professor Milne had lately invented an instrument which seemed to combine all requirements.

2. "On the Life History of a Moth, *Epyaxa rosearia*," by Mr. A. Purdie, M.A. (*Transactions*, p. 208.)

3. "On a New Vegetable-eating *Pill-millipede*," allied to the Spider and the Crustacea, which he proposed to call *Zephronia novæ-zealandiæ*, by Mr. T. W. Kirk. (*Transactions*, p. 139.)

4. "On the Eclipse of 9th September, 1885. (*Transactions*, p. 375.)

21st October, 1885.

Dr. Newman, President, in the chair.

Papers.—1. "On the Maori Language, with Remarks on English Spelling," by Mr. J. C. Crawford. (*Transactions*, p. 46.)

The Hon. Mr. Mantell agreed with the author in regard to the spelling and bad pronouncing of the Maori language by the English.

2. "On the Age of the Napier Limestone," by Mr. A. McKay. (*Transactions*, p. 367.)

3. "On a New Mineral, *Awaruite*," by Mr. W. Skey, Colonial Analyst. (*Transactions*, p. 401.)

4. A large trout, caught by Major Eccles in the Silverstream, was exhibited, and Dr. Hector, after examination, considered it was not a Californian salmon, but the same form of trout which is common in Otago, Canterbury, and Nelson, and that it is probably the progeny of the variety known as "Thames brown trout," which were first introduced into Tasmania, and thence distributed to New Zealand. The fish caught in the Silverstream was a female, with the roe just commencing to develope, and its stomach contained food of fresh-water origin. At first sight it appeared to be very similar to the Californian salmon.

25th November, 1885.

Mr. Govett, Vice-President, in the chair.

New Member.—Mr. G. V. Hudson.

It was announced that the Council had nominated Dr. Hutchinson to vote in the election of Governors of the New Zealand Institute, and this was confirmed by the meeting.

Papers.—1. "On the Coniferous Plants in the Botanic Gardens at Wellington," by J. Buchanan, F.L.S.

Dr. Hector, who read this paper, said that it was a most valuable contribution, containing a complete list of trees grown in the gardens, with remarks on the habits of the trees and the influence of the climate on them, also remarks as to the attack of blight on these pines. The author pointed out the advisability of growing more trees of the gum family. This was the last work of Mr. Buchanan, and would be most useful in future planting in this colony.

Mr. Kirk agreed with what Dr. Hector said. He thought this good work should be continued, and that specimens of these introduced plants should be placed in the museums. He hardly thought the gums would prove a good substitute for the pines. Mr. Kirk gave some interesting information respecting the growth of gum trees in other countries.

Mr. Maxwell remarked that the blue gum timber cut in New Zealand shrunk to a great extent, he supposed owing to want of age.

Mr. Tregear said that this question of the quality of these timbers could only be settled after having been locally studied.

2. "On the Habits of the South Island Weka, or Woodhen," by Mr. Smith, of Oamaru. Communicated by Dr. Buller. (*Transactions*, p. 131.)

Before proceeding with the paper, Dr. Buller gave a most interesting account of these birds, and exhibited specimens of the different species.

Exhibits :—(1) Cast of a male trout, caught beyond the Hutt Bridge by Mr. Pearcy. It weighed 12lbs., and was similar to the one exhibited at a previous meeting. (2) Photograph of the plant *Fourcroya longæva*, now flowering in the Botanic Gardens, taken by Mr. Davis. (3) Rocks from the Bounty Islands and Antipodes Islands, collected by Captain Grey of the *Stella*; and a collection from Campbell Island, presented by Captain Greig of the *Kekeno*. (4) An old map of New Zealand (1846), presented to the Museum by Mr. Evans.

Annual Meeting. 1885–86.

Abstract of Report.

During the year seven general meetings of the Society were held, at which twenty-five papers or short notices had been read.

Nine new members have been added to the roll, making a total of 270 members. A Microscopic Section of the Society has been formed, and a statement by the Chairman of the section is attached to this report. Fortnightly meetings of the section are held in this room, and members who wish to join can do so by applying to Mr. Maskell, the Chairman.

Library.—A catalogue has been compiled by the librarian, in which are included all the publications belonging to the Society, with those of the New Zealand Institute, the former being identified by a stamp upon each work. The total number of volumes belonging to the Society now in the library is upwards of 1,300. The works added to the various sections in the library during the year are: donations, 10 vols., and 56 purchased. There are still a large number of new works already ordered, but not yet received; and besides this, the members have the advantage of using the large donations which are added yearly to the Institute Library. Eighteen of the best scientific journals, British and American, are received regularly.

The balance-sheet appended shows the receipts to have been £322 1s. 8d., including the balance brought forward from the previous year (£195 0s. 8d); the expenditure, £176 6s. 4d.; and the balance now in hand, £145 15s. 4d.

Report of the Microscopic Section of the Wellington Philosophical Society.

The section has held numerous meetings during the year. Having decided that the definite work of the section should be the investigation of the fresh-water Infusoria of the Wellington District, the members have devoted themselves exclusively to this work, the result of which is shown in the paper submitted with this report, containing a catalogue of 44 genera, containing 43 species believed to be identical with those of other countries, and 7 species which the section, after full cosideration, believe to be new to science.

Having ascertained that the genus *Vorticella* had already been studied by Mr. T. W. Kirk, and that he had in preparation a paper on that alone, the members of the section decided to omit all study of the genus, and the *Vorticellæ* of Wellington are given in a separate paper by Mr. Kirk, read before a meeting of the section, and also submitted with this report.

The section ventures to hope that the Society will afford greater assistance to microscopical investigation, by the purchase of works of reference necessary for the study of particular subjects, such as Kent's "Infusoria," Schmidt's "Atlas of the Diatomaceæ," Ralfs' "Desmidiæ," Rabenhorst's "Algæ," and many others that could be named.

In view of the importance of microscopic study in a new country like this, the section would beg to suggest that the Council should make such additions to the library.

W. M. Maskell, Chairman of Section.

Papers.—1. "On the Metamorphosis of a species of Caddis Fly (*Phryganedæ*)," by G. V. Hudson. (*Transactions*, p. 213.)

2. "On an Edible Fungus (*Cyttaria purdiei*)," by John Buchanan, F.L.S. (*Transactions*, p. 317.)

3. "On *Vorticellæ*," by T. W. Kirk. (*Transactions*, p. 215.)

4. "Journey to Murimotu and Ascent of Ruapehu," by J. Park.

5. "Additional Contributions to the Flora of Nelson," by T. Kirk, F.L.S. (*Transactions*, p. 318.)

6. "On a new Variety of Desmid (genus *Triploceras*, Bailey)," by W. M. Maskell, F.R.M.S. (*Transactions*, p. 325.)

Election of Office-Bearers for 1886 :—*President*—Dr. Hector, C.M.G., F.R.S.; *Vice-presidents*—Dr. Hutchinson, W. T. L. Travers, F.L.S.; *Council*—Martin Chapman, Hon. G. R. Johnson, W. M. Maskell, F.M.S.; A. de B. Brandon, jun., Charles Hulke, F.C.S., Dr. Newman, R. H. Govett; *Secretary and Treasurer*—R. B. Gore; *Auditor*—W. E. Vaux.

AUCKLAND INSTITUTE.

First Meeting. 1st *June*, 1885.

J. A. Pond, President, in the chair.

New Members.—Mrs. E. Craig, S. Eastham, C. Hudson, J. Kenderdine, J. S. Rutherford, W. Tait.

1. The President delivered the anniversary address.

Abstract.

It is a pleasing duty, in opening this session, to say that, from a monetary point of view, we are in a position of comfort, if not affluence, by the substantial legacy of the late Mr. E. Costley, and the endowment of land by the New Zealand Government. The effect of these gifts will be felt in the future by the increased usefulness of this Institute to aid in the advance of science and natural history, and thus directly to assist in the development of the resources of our colony, and also in conserving that portion of our fauna, as far as possible, which seems doomed to extinction by the advance of new and probably more fitted forms of life.

After reviewing the progress of the colony during the last fifteen years, he proceeded to discuss the sources of natural wealth in the colony, under the divisions of Agriculture, Mining, Manufactures. With reference to them he made the following important remarks:—

With the enrichment of the food supplies of the sheep, and the introduction of imported grasses in the place of some at least of the native ones, it will be possible to still further improve the staple, largely increase the carrying capacity of the land, and consequently our producing power.

Now, chemistry has taught us that the soil does not contain an endless store of fertilisers in a soluble form favourable for plant food, and so capable of yielding the amount of nutrition demanded by an unlimited number of stock; and it must not be forgotten that, in the export of our millions sterling annually, we are also drawing largely upon the stores of valuable material which a long course of years has made available for us in the natural decomposition of the soils.

Let us see, then, what science teaches us in reference to our losses by these exports, of which we are so justly proud.

In the year 1883 our statistics tell us that our export of wool amounted to 28,125 tons, while chemistry informs us that this immense mass of wealth carried away with it also—

Potash to the amount of 1,216 tons.

Nitrogen, equal to ammonia, to the amount of 4,734 tons.

Here we have a loss not generally considered. Possibly the nitrogen of the air may gradually replace that which has been carried away, but the potash is actually a factor of our wealth gone from us.

In respect to the export of grain for that year, we find that the weight of wheat exported amounted to 131,250 tons, and the weight of valuable fertilisers lost with it are in the following proportions:—

Nitrogen, equal to ammonia	3,270 tons.
Phosphoric acid	1,127 "
Potash	704 "

It will be interesting to see the intrinsic value of these fertilisers. The weight of nitrogen as ammonia from both the wool and wheat is 8,000 tons, and this, calculated at a basis of £15 per ton for sulphate of ammonia, is equal to about £400,000.

The weight of potash from both the wool and wheat is 1,920 tons, which, calculated at the English market rate, comes to £57,600.

The phosphoric acid in the wheat is equal to 5,000 tons of bones, which, at £7 per ton, brings the value to £35,000.

These results, it must be remembered, are for one year.

It was this consideration which led me to urge that care should be shown in attending to the plant food, while considering the pastures of the

In the near future we shall be more forcibly brought to face these losses, as undoubtedly we shall export large quantities of meat, some preserved and some fresh. In the former case the loss will be large, but in the latter it will be much greater; as in the former we shall, at all events, retain the bone to be returned to the land, but in the latter case it will be nearly all loss. Unfortunately, the agriculturist has but little of the effete matter returned to his soil from the actual material withdrawn. The utilisation of the waste matter of our towns is still an unsolved problem, and he who can bring this to a satisfactory issue will indeed deserve the thanks of his fellow men.

While we are reviewing the export of cereals, it will be wise to consider for a moment the immense return from our lands over those of the adjoining colonies. Choosing wheat for the purpose of comparison, though oats, barley, hay, and potatoes show the same excess, and taking the average of ten years from 1873 to 1883, we find the bushels per acre as follows:—New South Wales, 14·92; Victoria, 12·38; South Australia, 7·9; Queensland, 12·5; West Australia, 11·; Tasmania, 18·23; New Zealand, 26·3; while the average return for eighteen years in the United Kingdom was 26·5.

To account for this excess in regard to this colony, we have either to accept as a reason the exhaustion of the lands in the colonies named, or the superior soil or more favourable climatic state of our own colony. On this subject, and reviewing the same disproportionate returns, McIvor gives his opinion on the ground of our much greater humidity, and I have no hesitation in arriving at the same conclusion. It is this constant humidity which causes the more speedy disassociation of the minerals, and the more prolific production of plant food. As we see in the cases of the deserts, it requires only water to clothe the sterile plains with vegetation. We must not, however, too heavily discount this most favourable state, or the loss will be greater than we anticipate. As I have already stated, our agricultural wealth is by far the greatest, and it should be our constant endeavour to still further enhance it. The choice of the most luxurious and enriching foods will yield us the greatest returns of butter and cheese from a given number of cattle, and the improvement of this stock alone will fully repay all our care and attention. Consideration should also be given to the cultivation of fibre-producing plants, as these may be sown and won by machine labour, and be sure of a never failing market.

I cannot leave the subject of agriculture without saying a few words on the sugar-beet. As you are aware, I have gone very fully into the examination of roots grown in this district, and find in regard to the amount of sugar contained in them, that they compare most favourably with the results obtained in Germany, and this, when grown with but a tithe of the care required in that country. Chemistry, again, has come to our aid, and shown that the sugar may be extracted in a much more expeditious and cheaper manner than heretofore, especially by the beautiful method of Scheibler and Lamont in the improved strontia process, and as each year passes, these improvements are becoming more practically available. At the same time, the Government of this colony have encouraged the establishment of this industry by large bonuses and protective duties, which should

go far towards making this a thriving work. That it will be carried successfully to completion I am confident, and, in that case, one of the most important results will be in the benefit to our stock by the additional nutritive food supplies, and the benefits to the land by the freeing it from the accumulation of weeds, which, in many parts of this district, in the lighter soils, proves a great drawback.

The subject of agriculture brings us immediately in contact with a wonderful array of insect life, affecting our crops, our fields, and our fruits. Some of them are actually beneficial to us, but the large majority are prejudicial. If we turn to some of the countries which have been ravaged by pests, we will obtain some idea of their magnitude, and the great difficulties and cost which have to be met before their number can be so reduced as to make it possible to continue the raising of the crops. It is but a few years since that the whole world was alarmed at the ravages of the *Doryphora*, better known as the Colorado beetle. Fortunately this pest speedily succumbed, and the alarm abated. Again, for years we have witnessed the efforts made in America and France to check the spread of the *Phylloxera vastatrix*. The loss to France alone from this pest has been so serious as to cause it to be mentioned as a national calamity; and the German Government has, after very large expenditure and repressive measures, been unable to keep that country free from this terrible visitant. In New Zealand, and in this district, we know that this pest has been already acclimated. The manner in which this has occurred does not concern us so seriously as the way in which this and several other pests may be best held in check or actually exterminated. It is here that science opens up a way of combatting these plagues. It is in the study of this insect life that we may hope to attain such a knowledge of their habits and enemies that will enable us to ensure their destruction, while the more careful study of those plants which are the most capable of resisting their aggression will make it possible, by judicious selection, of reducing their harmfulness to a minimum, at the same time cultivating the assistance we may obtain from protection and multiplication of the insects that prey upon those which so injuriously affect us. This work can only be done by the earnest efforts of our entomologists, and I feel it my duty, on behalf of this Institute, to say how indebted we are to the constant and earnest researches made in the study of the Coleoptera of New Zealand by Mr. T. Broun. In the present aspect of knowledge, it is the specialist alone who can make any advance in original research. To the student who has chosen for his theme chemistry, physics, agriculture, or mechanics, the prizes which await his earnest efforts are certain and great, but to those who enter the arena of original research in many of the other branches of science the honours are few, and these alone are the reward.

The study of entomology may prove of great value, not alone in the effort to rid ourselves of a present evil, but to guard against its importation. I have spoken of a few of the pests which affect our success in agriculture, but there is one which, though happily not a denizen of Australasia, may become so unless sufficient supervision is exercised, and the effect of its becoming acclimatised in Australia would be ruinous beyond calculation. I allude to the *Œdipoda migratoria*, better known as the locust. The importation of this insect may not appear feasible; but when we bear in mind how close the countries of its habitat are brought to the shores of Australia by means of the direct steamers, and the risks in importing the fruits of those countries of also obtaining the ova or larvæ of this insect, I do think trouble or expense should not be considered in the efforts to keep these colonies free from this terrible plague. In Cyprus, where the destructive ravages of this pest have been felt severely, the British Government have at great expense done much to reduce their number. In 1881, during the autumn and winter, 1,330 tons of their eggs were destroyed, and 56,116 millions of larval locusts were destroyed by traps and screens. Some idea of the extent of the operations may be gathered from the fact that in one

district there was a continuous line of screens, without a break, for 27 miles in length, arranged in three great loops, connected by a common centre.

These results are of such magnitude, and the ravages of this insect so serious, that I do not hesitate to bring this subject before this Institute, and from this before the kindred societies of the adjacent colonies. Any efforts that are made to guard against such a danger are worthy every consideration, for such a calamity as the introduction of this scourge into Australia, with its vast plains but partially peopled, with such an extent of breeding ground, would result in an increase before which that of Cyprus would be trivial, and the effects upon the Australian Colonies disastrous. It is true that there might be but little risk to this colony; but any serious misfortune affecting the adjacent colonies would also prove injurious to us.

So far, we have been careless to a degree of culpability in not taking steps to guard against the importations of several of these pests, more especially the Codlin moth and Phylloxera, and are still lax in our action in not discovering or introducing means for eradication. The combination of the Australian Colonies to deal with these questions is a matter which has already had a precedent in the expenditure of £40,000 at Geelong in the attempt to exterminate the Phylloxera.

He next reviewed the progress made in meteorology and mining, and concluded with a mention of the chief manufacturing industries, and sources of power that can be utilized.

2. "New species of *Carabidæ*," by Captain T. Broun. (*N.Z. Coleoptera.*)

3. "On a new species of *Chromodoris*," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 137.)

4. "Notes on the Stitch-bird (*Pogonornis cincta*)," by A. Reischek. (*Transactions*, p. 84.)

Second Meeting. 29*th June*, 1885.

J. A. Pond, President, in the chair.

New Members.—D. R. S. Galbraith, W. Goldie, W. F. Hubbard, C.E., G. W. Owen.

Papers.—1. "Objections to the Theory of Evolution," by J. Buchanan.

Professor Thomas criticised the paper at considerable length, and further discussion was postponed until the next meeting.

2. "On the Growth of Transplanted Trees," by J. Baber, C.E. (*Transactions*, p. 311.)

Third Meeting. 27*th July*, 1885.

J. A. Pond, President, in the chair.

New Members.—T. L. Bates, F. Ireland.

The President alluded to the recent death of Mr. J. T. Mackelvie, for many years past a most liberal benefactor of the Institute. Several other members also spoke in reference to the active interest and sympathy always evinced towards the Institute by Mr. Mackelvie.

Papers.—1. "The Maintenance of the Sun's Heat," by Professor F. D. Brown. (Abstract, *Transactions*, p. 394.)

2. "Notes on Parkinson's Petrel (*Procellaria parkinsonii*)," by A. Reischek. (*Transactions*, p. 87.)

3. "Notes on Gould's Petrel (*Procellaria gouldi*)." by A. Reischek. (*Transactions*, p. 90.)

Fourth Meeting. 24*th August*, 1885.

Hon. Colonel Haultain in the chair.

New Member.—J. Coom, C.E.

Papers.—1. "Notes on Cook's Petrel (*Procellaria cookii*)," by A. Reischek. (*Transactions*, p. 92.)

2. "The Sphygmograph," by J. Murray Moore, M.D.

The author traced the development of pulse-recorders generally, from the first ingenious attempts of the Rev. S. Hales to measure the force and rhythm of the arterial pulsations of the lower animals, to the later experiments of Viererdt in Germany, and Marey in France, on the human subject. The construction of Dudgeon's sphygmograph, the instrument now in general use, was fully explained, and its mode of action pointed out. A large number of diagrams of pulse tracings were exhibited, and the differences in the tracings produced by the action of certain diseases on the circulatory system was clearly and fully demonstrated.

3. "Prehistoric Weapons," by J. Martin, F.G.S.

This was a verbal description of certain stone, bone, and bronze weapons from the Swiss lake-dwellings, presented to the Museum by the late Mr. J. T. Mackelvie, and a comparison between them and similar articles from other parts of Europe and North America. Mr. Martin's remarks were copiously illustrated by lime-light views and diagrams.

Fifth Meeting. 21*st September*, 1885.

J. A. Pond, President, in the chair.

New Members.—E. Bell, Captain Clayton, G. Cozens, W. Macgregor Hay.

Papers.—1. "Notes on the New Zealand Puffin," by A. Reischek. (*Transactions*, pp. 93 and 95.)

2. "On a new Variety of the *Tuatara*," by A. Reischek. (*Transactions*, p. 108.)

3. "The Influence of the Means of Transit on the Social Condition of the People," by S. Vaile.

Sixth Meeting. 19*th October*, 1885.

J. A. Pond, President, in the chair.

New Member.—L. Cussen.

Papers.—1. "Description of New Zealand Spiders," by A. T. Urquhart. (*Transactions*, p. 184.)

2. "The Minerals of the Cape Colville Peninsula," by J. A. Pond.

3. "Observations on the Habits of New Zealand Birds," by A. Reischek. (*Transactions*, p. 96.)

Seventh Meeting. 30*th November*, 1885.

J. A. Pond, President, in the chair.

1. The President called attention to the Maori Carved House, or *Pataka*, erected in the Museum at the expense of Mr. F. D. Fenton. An unanimous vote of thanks to Mr. Fenton was passed.

2. "Descriptions of three new Species of *Coprosma*," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 315.)

3. "Notes on the Habits of Pole-cat, Ferret, Stoat, and Weasel," by A. Reischek. (*Transactions*, p. 110.)

4. "An Account of the new Volcano in the Friendly Islands," by Rev. S. W. Baker. (*Transactions*, p. 41.)

Dr. Murray Moore read the following extract from the official log of the schooner *Maile*, Captain Lane, in reference to the same volcanic outburst:—

"Position at noon, Friday, 16th October, 1885: longitude, 175° S.W.; latitude, 20° 15′ S. Observed columns of smoke shooting into the air, bearing W.S.W., about 20 miles away. Kept away, and ran within seven miles of it, when we found it to be an active volcano, and that it had thrown up an island about one mile long and over 100 feet high in the centre, sloping gradually all round, with a crater on the E.N.E. side, from which immense columns of matter were thrown continually to a great height; said matter falling again has evidently formed the island, as the crater is on the weather side, and nothing to windward but a low ledge. At sunset the eruption was almost over, only a small jet now and then appearing. The position of the volcano is—longitude 175° 25′ W.; latitude 20° 20′ S.

"[While going before the wind, and when seven miles to windward of the island, some fine gritty dust fell on the deck, which I believe to be pure scoria ash from the volcano.]

"Nov. 21st, 1885.—Left Tonga for Auckland. The volcano is still active; a party, just returned from there in the schooner *Jiole Tafa*, report the island four miles long and 300 feet high. The columns of smoke, etc. shot into the air are visible at Nukualofa anchorage, 47 miles N.N.W., the bearing from thence exactly agreeing with the position formerly given.

W. S. Lane."

5. "The Building Timbers of Auckland," by E. Bartley. (*Transactions*, p. 37.)

Mr. T. Peacock, M.H.R., said he had no doubt that discrimination was necessary in the selection of timber for different purposes. He took excep-

tion to the suggestion Mr. Bartley had made, that the durability of the timber was affected by the time of year the kauri was cut down. After inquiry, he had come to the conclusion that the season did not so much affect a slow-growing tree like the kauri. That was the opinion of experienced persons. As to the statement that the timber was cut too young —2 feet 6 inches was mentioned by Mr. Bartley, which was the minimum size contractors were allowed to cut—he thought the remark made as to 9 inches of sap was not applicable to all districts. He had seen young trees cut, and the sap was only a couple of inches, and perhaps not that. He thought the paper a valuable one, and further investigation might take place in the same direction.

Mr. John Buchanan was a little surprised to hear the wholesale condemnation of kahikatea. His observation on this matter extended over twenty-four years. He knew one house built of kahikatea which had been up for forty years—he referred to Mr. Thorpe's house in the Upper Thames. The timber was decayed at certain parts, but only in those portions of the building where other timbers would be, and certainly not more than other timbers. He had used kahikatea, and had not found the dry rot take place. He had made considerable inquiry from people at the Thames, where it was almost universally used, and he had heard nothing of dry rot. He thought the time would come when kahikatea would be a most valuable timber. The kahikatea he referred to was that grown in swamps; that from Bagnall's mill, for instance, and other parts of the Thames. From his knowledge of the subject, gained from various sources, he thought Mr. Bartley's statement should have been somewhat qualified.

The President (Mr. J. A. Pond) also took exception to Mr. Bartley's statement about kahikatea, and could instance the same house as Mr. Buchanan. From examinations he had made, the hardest kinds came from the swamps. He might mention that a house only a short distance from Thorpe's was bad with rot after standing only three or four years. The property of absorption was very marked in some classes of this timber, and was really the cause of the decay. In the case of one house at Te Aroha, where decay had set in some parts, he blamed to a certain extent the too early painting of the timber. He had given a good deal of time to the subject of the cutting of timbers. He had been assured by mill-owners of twenty and thirty years' experience that there was a great difference between timber cut in winter and that cut in spring and summer. He had verified the fact of the very free discharge of sap in spring and summer. As to totara, there was a house on the wharf where the whole sap and heart had gone in one piece of wood, and this was only after three years, Mr. Bartley had divided kauri into four classes. Whether that was so, or whether the appearance was owing to the location, he was not able to decide, but he rather favoured the theory of location.

7. "The Survival of the Fittest," by E. A. Mackechnie.

ANNUAL MEETING. 22*nd February*, 1886.

J. A. Pond, President, in the chair.

New Member.—W. A. Graham.

ABSTRACT OF REPORT FOR 1885.

Twenty new members have been elected during the year. The losses have been 24 in all, and may be classified as follows:—From death, 5; from resignation, 8; and from non-payment of subscription, 11. The number on the roll of the Institute at the present time is 300. Regret is expressed at

the death of Mr. J. T. Mackelvie, for many years a most liberal donor to the museum and library.

The total revenue paid into the general account has been £975 1s. 8d. The members' subscriptions have yielded £263 11s., and £582 10s. 10d. have been received as interest on investment. The expenditure has reached a total of £1,078 3s. 3d., thus leaving a debit balance of £103 1s. 7d. The investments standing in the name of the Institute have reached a total of £10,063.

Acting on the authority of a special general meeting of the Institute, the real and personal property of the Institute has been vested in the hands of the Trustees appointed under the Auckland Museum Endowment Act. The Trustees have been incorporated under the provisions of "The Religious, Charitable, and Educational Trust Boards Act, 1884," under the name of the Auckland Institute and Museum Trust Board.

Seven meetings have been held during the year, at which 21 papers on various literary and scientific subjects have been read.

Election of Officers for 1886 :—*President*—Professor F. D. Brown, B.Sc. ; *Vice-presidents*—J. A. Pond, H. G. Seth Smith ; *Council*—J. Baber, C.E., C. Cooper, Hon. Colonel Haultain, E. A. Mackechnie, J. Martin, F.G.S., J. M. Moore, M.D., T. Peacock, M.H.R., Rev. A. G. Purchas, M.R.C.S.E., S. P. Smith, F.R.G.S., J. Stewart, C.E., Professor A. P. Thomas, F.L.S. ; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S., F.Z.S. ; *Auditor*—J. Reid.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

FIRST MEETING. *7th May*, 1885.

Dr. W. H. Symes, President, in the chair.

New Member.—Dr. Moorhouse.

1. The President read a letter from the widow of the late Dr. F. von Hochstetter, thanking the Institute for the letter of condolence that had been sent to her, and forwarding a heliogravure of the late Dr. von Hochstetter. He announced that the heliogravure would be framed, and hung in the rooms of the Institute.

Paper.—2. "Lucretius," by Professor Haslam.

SECOND MEETING. *4th June*, 1885.

Dr. W. H. Symes, President, in the chair.

Paper.—1. "Buddha and his Philosophy," by Mr. George Hogben.

THIRD MEETING. *2nd July*, 1885.

Dr. W. H. Symes, President, in the chair.

New Members.—Miss Lohse and Miss Wilson.

Paper.—1. "River Terraces," by Professor F. W. Hutton.

FOURTH MEETING. *6th August*, 1885.

Dr. W. H. Symes, President, in the chair.

New Members.—Rev. T. Taylor, Drs. Deamer and Robinson, Messrs. Gill, Neish, and Chrystall.

Papers.—1. "On the Classification of the Algæ," by R. M. Laing, M.A. (*Transactions*, p. 299.)

2. "On the Brown Sea-weeds of Banks Peninsula," by R. M. Laing, M.A. (*Transactions*, p. 303.)

3. "The Wanganui System," by Professor F. W. Hutton. (*Transactions*, p. 336.)

Special General Meeting. *6th August*, 1885.

Dr. W. H. Symes, President, in the chair.

1. On the motion of Professor F. W. Hutton, it was resolved "That the word 'two' in Law VII. be omitted." This resolution gives to each member the right to admit an indefinite number of visitors to the ordinary meetings.

Fifth Meeting. *3rd September*, 1885.

Dr. W. H. Symes, President, in the chair.

New Members.—Messrs. W. H. Spackman and J. Deans.

Paper.—1. "Thought Transference," by Mr. R. M. Laing, M.A.

Sixth Meeting. *1st October*, 1885.

Dr. W. H. Symes, President, in the chair.

New Member.—Rev. Canon Stanford.

1. Professor F. W. Hutton delivered a lecture on "The Stone Age in Europe."

2. *Papers.*—"Descriptions of New Zealand Micro-Lepidoptera," by E. Meyrick, B.A. (*Transactions*, p. 162.)

3. "Notes on the Nomenclature of the New Zealand Geometrina," by E. Meyrick, B.A. (*Transactions*, p. 184.)

Annual Meeting. *5th November*, 1884.

Dr. W. H. Symes, President, in the chair.

Annual Report.

Eight ordinary meetings and one special general meeting have been held, at which sixteen papers have been read. During the year 13 new members have joined the Institute, but 27 have retired, so that the number of members at present on the books of the Institute is 135. Several additions have been made to the library, and an order for a considerable number of new books, including a complete set of the "Geological Magazine," has lately been sent to London. At the suggestion of the Otago Institute, your Council has again passed a resolution strongly recommending the publication of a new Handbook of the Phanerogamic Flora of New Zealand. Copies of this resolution were sent to the Otago Institute, the New Zealand Institute, and the Colonial Secretary; and it is hoped that the Government will be induced to undertake the work, as it is, in the opinion of your Council, urgently required.

The balance sheet shows total receipts, including credit balance of £13 6s. 7d., to be £204 4s. 2d.; total expenditure, £164 2s. 8d., leaving a credit balance of £40 1s. 6d. The reserve fund, consisting of the subscriptions of life members, is now £56 9s. 7d.

Election of Officers for 1886.—*President*—A. D. Dobson; *Vice-presidents*—W. H. Symes, M.D., and Geo. Hogben, M.A.; *Hon. Treasurer*—H. R. Webb; *Hon. Secretary*—Charles Chilton, M.A.; *Hon. Auditor*—C. R. Blakiston; *Council*—Professors Hutton and Haslam, Messrs. C. E. Bevan, Brown, R. W. Fereday, T. Cook, S. Hurst, Seager.

The retiring President delivered an address on "The rôle of Phosphorus in Nature."

Additional Meeting. 26*th November*, 1885.

A. D. Dobson, President, in the chair.

Papers.—1. "Moas and Moa Hunters," by Professor J. von Haast, C.M.G., Ph. D., F.R.S.

2. "Some Observations on the Stone Weapons of the Morioris and the Maoris," by Professor von Haast, C.M.G., Ph. D., F.R.S. (*Transactions*, p. 24.)

3. "A new species of *Philygria*," by Charles Chilton, M.A. (*Transactions*, p. 159.)

OTAGO INSTITUTE.

First Meeting. 12*th May*, 1885.

Professor Scott, President, in the chair.

The meeting took the form of a conversazione.

Second Meeting. 10*th June*, 1885.

Professor Scott, President, in the chair.

The following resolution was proposed by Mr. G. M. Thomson, and was carried unanimously:—"That the Institute draw the attention of the Government to the recent wholesale deportation of Tuatara lizards which has taken place from this colony, and respectfully suggest that steps be taken to preserve these animals in the localities in which they still occur."

Papers.—1. "Notice of some new Native Plants," by D. Petrie, M.A. (*Transactions*, p. 296.)

2. "On an Index-Collection for small Zoological Museums, in the form of a Genealogical Tree of the Animal Kingdom," by Professor Parker. (*Transactions*, p. 73.)

Third Meeting. 23*rd June*, 1885.

Professor Scott, President, in the chair.

Mr. G. M. Thomson and Professor Parker gave a microscopical demonstration "On the Preparation of Vegetable Tissues."

Fourth Meeting. 14*th July*, 1885.

Professor Scott, President, in the chair.

Professor Black delivered a lecture on "Explosives."

Fifth Meeting. 21*st July*, 1885.

Professor Scott, President, in the chair.

Professor Black delivered his second and concluding lecture on "Explosives."

SIXTH MEETING. 11*th August*, 1885.

Professor Scott, President, in the chair.

New Members.—Arthur Kitchener, J. W. Moore.

Papers.—1. The Secretary read a paper "On the Habits of the Black Woodhen, and of the South Island Crow," by A. Reischek. (*Transactions*, p. 105.)

2. "Note on a Skeleton of *Notornis*, recently acquired by the Otago University Museum," by Professor Parker. (*Transactions*, p. 78.)

3. "Description of a new Species of *Acæna*," by D. Petrie, M.A.

4. "On Inebriety, and the Duty of the State with regard to Inebriates," by Dr. De Zouche.

The following resolutions, proposed by Mr. G. M. Thomson, were adopted:—

(1.) "That, as no work dealing with the systematic botany of New Zealand is how available, the Institute again bring under the notice of the Government the desirability of having a new Handbook of the Phanerogamic Flora of New Zealand prepared and printed, and respectfully urge that steps be taken to have such a work carried out."

(2.) "That as such a work would, in course of time, be largely taken up, so that most of the cost of publication would be ultimately recouped, this Institute undertake to guarantee the disposal of 100 copies, provided the retail selling price of such work does not exceed twenty-one shillings."

(3.) "That copies of these resolutions be sent to the other affiliated Societies of the New Zealand Institute, asking their co-operation in this matter."

SEVENTH MEETING. 25*th August*, 1885.

Professor Scott, President, in the chair.

Dr. Lindo Ferguson gave a microscopical demonstration "On the Preparation of Sections of Bones and Teeth."

Professor Ulrich gave a microscopical demonstration "On the Preparation of Rock Sections."

EIGHTH MEETING. 8*th September*, 1885.

Professor Scott, President, in the chair.

Professor Parker exhibited a pair of very fine trout from Lake Wakatipu, stuffed by the Museum taxidermist.

Dr. Hocken's lecture "On The Early History of New Zealand" was postponed until the next meeting.

NINTH MEETING. 22*nd September*, 1885.

Professor Scott, President, in the chair.

New Member.—Captain Boyd.

Dr. Hocken gave the fourth of his series of lectures "On The Early History of New Zealand."

TENTH MEETING. 13*th October*, 1885.

Professor Scott, President, in the chair.

Paper.—"Regarding Evolution the Previous Question of Science," by the Rev. Dr. Macgregor.

ANNUAL MEETING. 10*th November*, 1885.

Professor Scott, President, in the Chair.

Papers.—"Critical List of the *Crustacea malacostraca* of New Zealand," by G. M. Thomson and C. Chilton. (*Transactions*, p. 141.)

Professor Parker exhibited some botanical models made by him, also a number of stuffed fishes and prepared skeletons, which were to be sent from the museum to the Colonial and Indian Exhibition, 1886.

ABSTRACT OF ANNUAL REPORT.

Eleven meetings have been held during the session. At four of these original papers were read.

During the session a resolution has been passed affirming the desirability of a re-issue of the phanerogamic portion of the "New Zealand Flora." A resolution has also been adopted on the question of the preservation of the tuatara.

Seven new members have been elected, making the total number 197.

The receipts of the session, including a balance of £97 8s. 3d. from last year, amount to £216 5s. 3d. The expenses, including £12 paid as a contribution of 1s. 6d. per member, towards the expenses of the "Transactions," amount to £187 5s., leaving a balance of £29. 0s. 3d. The reserve fund in the Post Office Savings Bank is now £193 3s. 8d.

ELECTION OF OFFICE BEARERS FOR 1886.—*President*—Professor Parker; *Vice-presidents*—Dr. Hockin and Mr. G. M. Thomson; *Honorary Secretary*—Professor Scott; *Honorary Treasurer*—Mr. J. C. Thomson; *Council*—Alexander Wilson, M.A., Dr. Petrie, M.A., D. Colquhoun, M.D., F. R. Chapman, J. De Zouche, M.D., H. Skey; *Auditor*—D. Brent, M.A.

The retiring President delivered an address.

ABSTRACT.

In the course of a general review of the work of the New Zealand Institute during the last seventeen years, he specially dealt with the science of anthropology, pointing out that the ethnological papers in the "Transactions" deal mainly with the Native race—the Maori—and much valuable information is to be found scattered through the volumes. In some respects this is all that could be desired, but some important questions are passed over almost in silence. The numerous papers of Colenso and others tells us much of their habits, history, traditions, and language; but no one has as yet taken up systematically the subject of Maori anthropometry. Here in the South Island we are placed at a great disadvantage. We have few Maoris, and these have largely intermarried with the white race; but in the North Island the Maori, though rapidly decreasing, according to almost all authorities, is still numerous, and it is to be hoped that someone will put on record a careful set of observations of

this kind before it is too late. This, one of the finest of the savage races, ought not to be allowed to pass into decadence before this is done. There are four papers of an anthropometric character in the "Transactions." Three deal with the colour sense of the Maori, and to these I shall refer again. One, read before the Wellington Philosophical Society by Mr. Knox, gives a short description of the skeleton of an aboriginal Chatham Islander. It is printed in volume v., and it is quite within our power to write papers of this kind down here. We may not have the living Maori, but we may surely have his bones, at least his skull. Much may be learned from a series of careful measurements of the skull alone, and this is a branch of the subject to which I shall willingly devote myself when opportunity offers. But I find that Maori skulls are not easily got. Collectors of Maori relics usually look on skulls as curios, and hoard them up in little private museums, where they lie hidden during the collector's lifetime, and after his death, not at all improbably, are lost, or, being unauthenticated, become useless for the purpose I speak of. There is nothing to prevent amateurs measuring and recording the skulls in their collections; but since Broca's time craniometry has become a not particularly easy matter, and the instruments required are expensive. It is, of course, a simple enough matter to take certain measurements of a skull, but the great value of an inquiry of this kind lies in the results being such as may be compared with the work of others. Thus all measurements ought to be done in the same way, and modern anthropologists almost invariably follow the directions of the distinguished Frenchman I have referred to, and for this system of measurements a number of special instruments are required. I hope the time will come when I shall be in a position to publish in our "Transactions" some addition to our knowledge of this subject. The other three papers are devoted to the colour sense of the Maoris, of their power to appreciate and distinguish colours. One of these, by Mr. Stack, is published in volume xii. The remaining two, by Mr. Colenso, are to be found in volume xiv. Perhaps a brief allusion to these papers will not be out of place. Some years ago a theory was propounded that primeval man was colour-blind, that the world to his sense of vision was dull and grey. The sky gave him no sense of blue; for him there was no green in the forests, no yellow, no red in the flowers or the sunsets; these and the rainbow affected our ancestors as but mixtures in varying proportions of black and white. That as the centuries passed on our colour sensations gradually came to us, first red, then orange, then yellow, then green, then blue. That the Homeric Greeks were at the stage of being able to distinguish red and yellow with their shades and mixtures, the second stage of the evolution of the colour sense according to this theory. From that day to this the education of this sense has gone on continuously, and we are now able to see the range of colour from red to violet, but much of the spectrum is yet unmastered. The principal supporters of this theory are Mr. Gladstone and Dr. Magnus, a German oculist. It is mainly by philological arguments that they endeavour to convince us of the truth of their theory, but it would be out of place to discuss the question now, suffice it to say that much was written on both sides in 1877 and 1878, and that two of the papers were read by Mr. Stack. If cultured Homeric man had a feeble colour sense, if green and blue had not then emerged from the pervading grey, then savage man of the present day will also most probably to some extent be colour blind. Mr. Stack, therefore, gives us the result of his 30 years' experience of the Maoris in this matter. Unfortunately, he looks at this experience in the light of the new discovery, and tries to make the two agree. The result is curious. He states decidedly that the Maoris have a very feeble colour sense in all colours; but though they are in advance of the besiegers of Troy, in that they have a certain slight appreciation of green, they were till quite lately still blind to blue, the colour they use in tatooing; also that on the arrival of the Europeans they *all at once* had revealed to them the entire scale of colour. This paper is not convincing, and is mainly interesting as being the cause of

Mr. Colenso's contributions. The conclusions arrived at were so much at variance with what he had been led to believe from his exceptional experience, that he felt he must not let them pass uncontradicted. The result is a very valuable contribution to Maori anthropology. He shows, to me most conclusively, that so far from the Maoris being deficient in sensibility to colour, they are in advance of most of us in that respect. He gives us instances from his own experience of this, and he tabulates a list of 80 words and phrases meaning red and its various modifications. He is very far indeed from believing in the blue-blindness of Mr. Stack. Indeed, one cannot read his paper and have any serious doubt as to the Maori possessing, and having possessed before the advent of the Europeans, a fine perception of colour. In this they agree with other savage races—races whose very existence often depends on their ability to note minute variations in colour. Mr. Grant Allen, who, in his interesting work on the evolution of the colour sense, gives a careful adverse criticism of the Gladstone-Magnus theory, publishes the result of an extended inquiry into the colour perception of existing uncivilized races. He sent out circulars to competent persons, missionaries, Government officials, and others, in all parts of the world, requesting answers to twelve questions regarding the colour sense of the savage people amongst whom they were living. The answers received "bore out in every case the supposition that the colour sense is, as a whole, absolutely identical throughout all branches of the human race." To complete our knowledge of the Maoris in this respect, and to make it more definite and exact, it would be well for someone to test a large number of them with some good colour test, such as Holmgren's wools. This could easily be done by anyone. Nothing but care and patience are required, but the results would be well worth recording. . . . I cannot let you go without alluding to the gaps that death has made in our ranks during the past year. Two of my predecessors in this chair, Mr. Arthur and Mr. Montgomery, have, like the runners of old, handed on the torch of life to others. These gentlemen were well-known and valued members of the Institute, and to both we owe regret and gratitude. Members of our body for a number of years, from first to last they had the interests of the Institute at heart, and in the various capacities of President, Vice-president, and member of Council, they were intimately associated with the many details of its management. Mr. Arthur was one of our oldest and most active members. He joined the Society in 1869, the year of its birth. From 1878 continuously till his death he was a member of the Council, or Committee of Management. He was Vice-president on two occasions, in 1878 and 1883, and he was our President in 1882. It will be long before we forget his enthusiasm as a worker in that branch of science to which he devoted his leisure. To it several of the volumes of the "Transactions" bear worthy and lasting witness. I do not think I go too far, or under-estimate the work of others, when I say that the success of fish culture in Otago is mainly due to Mr. Arthur's zeal and fostering care. Mr. Arthur's papers in the "Transactions" on fishes show where his tastes lay. Up to the last he lost no opportunity of observing and recording what he could of our fishes, native and introduced. Of literary tastes, Mr. Montgomery did not contribute much in the way of papers to our proceedings. But much helpful work may be done in an organisation such as ours in other ways, and in such Mr. Montgomery was always ready and willing to assist. He joined the Society in 1877, and as President in 1883, Vice-president in 1881 and 1884, and as member of Council from 1879, he did good work for us, heartily doing what came to his hand to do.

WESTLAND INSTITUTE.

Abstract of Nineteenth Annual Report.

The number of members on the roll is 93, and the total receipts, including a balance of £65 13s. 3d., carried forward from last year, amounts to £204 13s. 11d. The expenditure has been £181 16s. 10d., of which £57 3s. 9d. has been spent on additions to the Library and Reading-room. The balance in hand and outstanding credits, after deducting liabilities, is £46 7s. 1d.

During the year there have been eleven meetings of the Committee for the transaction of business.

Election of Officers for 1885-86.—*President*—T. O. W. Croft; *Vice-president*—J. P. Will; *Treasurer*—C. F. A. Broad; *Committee*—W. A. Spence, Wm. Kenny, Jno. Nicholson, H. L. Robinson, A. H. King, C. Horgan, E. B. Sammons, J. W. Souter, G. Clarkson, Captain Bignell, James Park, Rev. H. Gould; *Secretary*—Richard Hilldrup.

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

First Meeting. 8th *June*, 1885.

The President, W. Colenso, F.L.S., in the chair.

The President gave an opening address.

Papers.—1. "On the Rev. J. Pearson's Method of Computing Solar Eclipses and Occultations," by J. Harding.

2. "On some Structural Peculiarities in the Sun-Fish (*O. mola*) recently captured at Napier," by A. Hamilton, of Petane. (*Transactions*, p. 135.)

A list of specimens received by the Curator for the Museum since the last meeting was then read. Amongst them was the baleen of *Neobalæna marginata;* the stuffed head of a Sea-Leopard Seal (*Stenorhynchus leptonyx*), from Porangahau, presented by Rev. F. E. T. Simcox.

The Hon. Secretary also showed a dried specimen of the Hammer Shark (*Z. malecolus*), procured at Port Ahuriri, and a collection of fossils from Takapau.

Second Meeting. 13th *July*, 1885.

The President, W. Colenso, F.L.S., in the chair.

Papers.—1. "On the Cryptogamic Flora of New Zealand," by W. Colenso, F.L.S. (*Transactions*, p. 219.)

2. "Notes on the recent Solar Eclipse," by J. Goodall, C.E. (*Transactions*, p. 375.)

3. Address by Thomas Tanner, (the Vice-President,) "On the Solar Eclipse," as observed by him at Woodville.

4. An Article by Mr. R. C. Harding, "On the Phenomena observed at Dannevirke, connected with the recent Solar Eclipse."

The Vice-president illustrated his remarks by a large diagram on the black-board, and the other notes were accompanied by diagrams.

Mr. Graydon, a visitor, exhibited a beautiful diagram of the corona, as observed by him.

Mr. Goodall illustrated his remarks on the spectroscopic peculiarities of the corona by exhibiting a spectroscope.

The specimens exhibited at this meeting were numerous, amongst others:—(1) The eggs and young of a species of *Phasma*, by the President. (2) The apex of the lower jaw of a Goosebeak Whale (*Epiodon*), showing the small imbedded teeth. (3) A photograph of a young Pike Whale (*Balænoptera rostrata*), killed at Port Ahuriri. (4) Some parasitic barnacles (*Coronula balænaris*), having *Conchoderma aurita* growing on them. These were exhibited by the Hon. Secretary, Mr. Hamilton.

THIRD MEETING. 12*th October*, 1885.

The President, W. Colenso, F.L.S., in the chair.

1. The President delivered a very interesting address "On the various Legends and Stories current among the Maoris relating to the Sea and Sea Monsters."

2. The Hon. Secretary exhibited a number of specimens recently deposited in the Museum, among others a specimen of a Flying-fish from the Bay.

A number of interesting fossils were exhibited, which had been collected from Pareora beds at the Upper Mohaka, including fine specimens of *Flabellum circulare.*

FOURTH MEETING. 9*th November*, 1885.

The President, W. Colenso, F.L.S., in the chair.

Paper.—1. Remarks "On Feathers of two Species of Moa," by Taylor White, Esq., of Glengarry. (*Transactions*, p. 83.)

2. An Address by the Hon. Secretary, Mr. Hamilton, "On the Circumstances attending the early Discovery of Moa Bones in New Zealand, and their Identification." Mr. Hamilton illustrated his remarks by reference to a nearly complete skeleton of a Moa, deposited in the Museum of the Institute.

3. The President exhibited some remarkably fine specimens of moa bones from the North Island of New Zealand, which had recently been reported on by Dr. von Haast, and found to possess great interest.

4. Mr. Colenso then gave an address "On some other Extinct Birds, more particularly the Dodo and the Great Auk."

Numerous botanical specimens from the Seventy-mile Bush were exhibited by the President and the Hon. Secretary.

Mr. White's paper was illustrated by specimens of moa feathers, and by two coloured drawings of the most noticeable feathers.

FIFTH MEETING. 14*th December*, 1885.

The President, W. Colenso, F.L.S., in the chair.

Papers.—1. "On *Clianthus puniceus*, Sol.," by W. Colenso, F.L.S. (*Transactions*, p. 291.)

2. "On the Bones of a new Species of Sphenodon (*S. diversum*) Col.," by W. Colenso, F.L.S. (*Transactions*, p. 118.)

3. "On some new Indigenous Plants," by W. Colenso, F.L.S. (*Transactions*, p. 256.)

4. "On some Introduced Plants" recently observed by W. Colenso, F.L.S. (*Transactions*, p. 288.)

5. The Hon. Secretary then read a list of the specimens added to the Museum, and gave a short address on the desirability of the study of Natural History, if only as an intellectual recreation.

The President then reviewed the work of the session, and at the close a vote of thanks was passed to Mr. Colenso for his valuable papers.

At the close of the meeting, Mr. Goodall exhibited some diagrams of the recent solar eclipse, published by the Surveyor-General.

Annual Meeting. *4th February*, 1886.

Abstract of Annual Report.

An account of the circumstances attending the removal of the property of the Society to their new premises, and drawing attention to the establishment of the Museum. The Library and donations of books. The number of members now on the roll is 149, 28 having been elected during the year. The audited statement of accounts shows a balance in Treasurer's hands of £ ; fixed deposit in bank, £150; and considerable arrears of subscriptions. The expenditure for the year was £ , principally on museum fittings, and expenses connected with removal.

Five meetings only have been held, at which nine papers have been read, and seven addresses and lectures delivered.

Ten Council meetings have been held.

Appended to report of Council is the Curator's report on the additions to the Museum during the year.

Election of Officers for 1886.—*President*—W. I. Spencer; *Vice-president*—J. Goodall, M.I.C.E.; *Council*—H. Hill, F. W. C. Sturm, S. Locke, N. Heath, J. T. Carr, A. P. Sheath; *Hon. Secretary and Curator*—A. Hamilton; *Hon. Treasurer*—J. N. Bowerman; *Auditor*—T. K. Newton.

SOUTHLAND INSTITUTE.

Annual Meeting. *26th January*, 1886.

Abstract of Annual Report.

During the year six general meetings were held, at which the following papers were read:—

1. "On the Discovery of a Crystal of Platinum in the Orepuki Black-sand," by Mr. W. S. Hamilton. (*Transactions*, p. 402.)
2. "On Sound," by Mr. A. Ireland.
3. "On the Geology of the Bluff District," by Mr. W. S. Hamilton.
4. "On Optical Illusions," by Mr. G. Baker.
5. "On Romance and Sensationalism," by the Rev. H. Stocker.
6. "On Respiration," by Dr. Macpherson.
7. "On Encrinites and Crinoids," by Mr. E. Webber.
8. "On Blood, and the Circulation," by Dr. Closs.
9. "On Population," by Mr. A. Ireland.

The Council arranged with Mr. Daniel for a course of popular lectures on "Chemistry." The attendance at these lectures, although not large, was encouraging.

The Council also assisted in organising a course of lectures on literary subjects, given during the winter months by Messrs. Brown, Wilson, and Waddell, of Dunedin, and Messrs. Gammell, Blanchflower, and Galbraith, of Invercargill.

According to a resolution carried at last annual meeting, the subscription has been reduced to half-a-guinea to those members who do not take the volume of "Transactions." This, as yet, has led to no increase in the roll of members. In the year 1884, 58 members paid one guinea each. In 1885, 17 members paid half-a-guinea each, and 37 members one guinea each, making a total of £47 15s. 6d.

The Library of the Institute has received a number of new works by purchase, and by generous donations of valuable books from the Survey Department of the United States Government, and the Victorian Government.

Including a balance of £57 8s. 5d. brought forward, the total income has been £121 19s. 11d., of which £16 16s. is the proceeds of the course of lectures. The expenditure has been £40 16s. 8d., besides which there is an outstanding account for books, of £20.

Election of Officers for 1886.—*President*—Dr. Galbraith; *Vice-president*—Ven. Archdeacon Stocker; *Council*—Messrs. Bailey, Scrutton, Mehaffey, Cuthbertson, and Dr. Closs; *Treasurer*—Mr. Robertson; *Secretary*—Mr. E. Webber.

NELSON PHILOSOPHICAL SOCIETY.

ANNUAL MEETING. *8th October*, 1885.

The Bishop of Nelson, President, in the chair.

New Member.—Mr. Alfred Jones.

The Secretary's report showed that during the year 9 ordinary and 10 Council meetings had been held, and that 9 original papers had been read before the Society. During the year 17 new members and two associates had been elected, and the total number stood at 95 members and three associates.

The Treasurer's report showed that the receipts for the past year had been £75 9s. 6d., and the expenditure £91 19s. 4d.

ELECTION OF OFFICERS FOR 1885–86.—*President*—A. S. Atkinson; *Vice-presidents*—The Bishop of Nelson and J. Meeson, B.A.; *Secretary*—Dr. Coleman; *Treasurer*—A. K. Somerville; *Council*—Dr. L. Boor, Dr. J. Hudson, J. Holloway, J. S. Browning, and W. S. Littlejohn; *Curator*—Dr. Hudson.

2nd November, 1885.

A. S. Atkinson, President, in the chair.

Papers.—1. "Observations on the Recent Solar Eclipse," by the Bishop of Nelson; (2) by J. Meeson, B.A.; (3) by Dr. Coleman; (4) by the President; (5) by Dr. Hudson. (*Transactions*, p. 375.)

6. "A Rain Chart for the Year," by the Bishop of Nelson.

The Bishop of Nelson was nominated to vote at the election of a Governor of the New Zealand Institute.

7th December, 1885.

A. S. Atkinson, President, in the chair.

Papers.—1. "On Telegraphy," by J. C. Lockley.

2. "A Description of the Stalactite Caves at Collingwood," by J. S. Browning.

APPENDIX.

Meteorology.

Comparative Abstract for 1885 and previous Years.

STATIONS.	Barometer At 9.30 a.m.		Temperature from Self-registering Instruments read in Morning for Twenty-four Hours previously.					Computed from Observations.		Rain.		Wind.		Cloud.
	Mean Reading.	Extreme Range.	Mean Temp. in Shade.	Mean Daily Range of Temp.	Extreme Range of Temp.	Max. Temp. in Sun's Rays.	Min. Temp. on Grass.	Mean Elastic Force of Vapour.	Mean Degree of Moisture (Saturation=100).	Total Fall in inches.	No. of Days on which Rain fell.	Average Daily Force in Miles for Year.	Maximum Velocity in Miles in any 24 hours, and Date.	Mean Amount (0 to 10.)
Auckland	30·170	1·290	58·3	12·5	42·0	149·0	29·0	·352	71	28·140	155	145	922 on 14th March.	6·1
Previous 21 years ..	29·964	..	59·2	..	..	..	..	·398	74	43·48	189	..		
Wellington	30·001	1·343	54·5	12·5	43·0	147·0	29·5	·356	84	36·813	162	163	600 on 19th Sept.	4·2
Previous 21 years ..	29·918	..	54·7	..	..	..	..	·336	72	52·486	158	..		
Dunedin	30·120	1·469	50·8	14·3	52·0	150·0	25·0	·275	74	24·598	167	120	600 on 15th March	5·7
Previous 21 years ..	29·864	..	50·3	..	..	..	..	·278	74	35·145	164	..		

Average Temperature of Seasons, compared with those of the previous Year.

STATIONS.	Spring. September, October, November.			Summer. December, January, February.			Autumn. March, April, May.			Winter. June, July, August.		
	1884.		1885.	1884.		1885.	1884.		1885.	1884.		1885.
Auckland	56·4	..	56·4	62·3	..	64·6	58·7	..	59·7	52·6	..	52·7
Wellington	52·6	..	53·5	58·8	..	60·6	54·3	..	55·6	48·8	..	48·3
Dunedin	49·4	..	50·6	54·7	..	56·4	50·3	..	51·7	43·7	..	44·7

NOTES ON THE WEATHER DURING 1885.

January.—On the whole, showery weather, but total rain under the average; temperature at all stations less than average; some bright, pleasant days; winds moderate. Earthquake felt in North on 15th, at 6.10 p.m., slight, N. and S.

February.—Except in South, the rainfall has been much less than the usual average for this month, and the weather on the whole has been fine, with light variable wind. Earthquake felt on 19th, in North Island, at 8.30 a.m.; very slight; brilliant meteor on 20th.

March.—Generally a wet, unpleasant month, with frequent squalls and cold weather.

April.—Fine weather, with generally light wind and small rainfall.

May.—Showery weather during this month, but no very heavy falls of rain. Wind, on the whole, moderate; temperature, below average.

June.—Fine weather during this period for time of year; little rain, and moderate or light wind; temperature rather above the average.

July.—Weather about the average for time of year. Earthquakes at Wellington, 18th, 9.43 p.m., and on 26th, 7.50 p.m., slight; also at Lincoln on 26th, at same time, slight.

August.—Rain rather under the average, and, on the whole, seasonable weather, though some severe days experienced in the South, with strong winds. Earthquake at Wellington on 5th, at 5.10 p.m., rather sharp.

September.—Generally fine weather during this month, with small rainfall, and about the average temperature.

October.—On the whole, fine for the time of year, except rain in excess at Wellington and squally weather; temperature about the average. Meteor on 20th, to eastward.

November.—Fine generally at all stations during the month, with moderate winds.

December.—Very fine weather at all places, the rainfall considerably under the average; and the temperature was less than the usual average for this month. Earthquake reported on 13th, at 7.15 a.m., and on the 20th, at 7.20 a.m., at Wellington.

EARTHQUAKES reported in NEW ZEALAND during 1885.

Place.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Woodville ..	15*	..	..	..	..	..	..	..	..	..	..	..	1
Hawera ..	..	..	20	..	..	..	..	..	..	..	..	..	1
Feilding ..	..	..	..	..	..	..	26*	..	..	..	..	..	1
Patea ..	..	..	..	..	..	..	26*	..	..	..	..	..	1
Foxton ..	..	..	..	..	9	..	..	5	..	..	..	..	2
Wanganui ..	15*	..	..	..	..	..	..	..	..	..	..	..	1
Wellington	15	19	..	..	..	..	18, 26	5*	..	..	..	13*	6
Blenheim ..	15*	..	..	..	..	..	26*	..	..	11	..	..	3
Nelson ..	15	..	..	..	..	..	..	..	..	..	..	..	1
Ross ..	..	..	..	..	..	20*	..	..	..	..	..	..	1
Christchurch	15	..	..	..	..	..	26*	..	..	..	..	..	2
Ashburton ..	..	..	..	..	..	..	26	..	27*	..	..	..	2
Lincoln ..	..	..	..	..	..	..	26	..	..	..	..	..	1
Timaru ..	..	..	..	..	..	..	..	..	27*	..	..	..	1
Westport ..	..	25*	..	..	..	..	26*	..	..	..	..	..	2
Greymouth	..	..	..	..	..	..	26*	..	..	..	..	..	1
Kumara ..	..	25*	..	..	..	..	..	..	..	..	..	..	1
Hokitika ..	..	25*	..	..	..	..	26*	..	..	..	..	..	2
Oamaru ..	..	27*	..	..	..	..	..	..	..	..	..	26*	2

The figures denote the day of the month on which one or more shocks were felt. Those with an asterisk affixed were described as *smart*, those with a dagger as *severe shocks.* The remainder were only slight tremors, and no doubt escaped record at most stations, there being no instrumental means employed for their detection. These tables are therefore not reliable as far as indicating the geographical distribution of the shocks.

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